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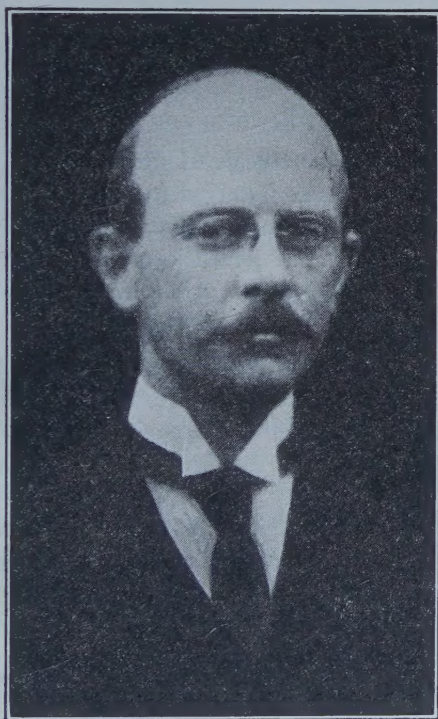
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Frederick Erskine Olmsted  
1872-1925

## FREDERICK ERSKINE OLMSTED

1872-1925

F. E. Olmsted, or Fritz Olmsted as he was known to all his friends, was born in Hartford, Connecticut, November 8, 1872. He graduated from the Sheffield Scientific School of Yale University in 1894 and entered the U. S. Geological Survey. While working on a topographic sheet in the vicinity of Ashville, North Carolina, he met Gifford Pinchot, who was then forester for the Biltmore Estate and learned from him what forestry was and the need of it in this country. Mr. Pinchot must have impressed him with the importance of technical training, for Olmsted went abroad and during the years of 1899 and 1900 he studied under Sir Deitrich Brandeis in India and in Germany.

When Mr. Pinchot took charge of the Division of Forestry in the Department of Agriculture and started to realize his vision of forestry in America, he gathered to him such men as F. E. Olmsted, Overton Price, Walter Mulford, E. T. Allen, Richard Fisher and E. M. Griffith, and Olmsted was appointed as an agent in the Division of Forestry, July 1, 1900.

He, perhaps more than any of those early pioneers in the profession, with the possible exception of Price, was one with Mr. Pinchot in the strength of his devotion to the ideals of the profession and the rightness of the cause. Those were the days of the fights against a wasteful governmental public land policy, an intrenched and hostile lumber industry and an apathetic public opinion. The fore-runners of the organization, who were later to take over the actual management, were a group of men who were set to locating what remained of the public owned timber lands with a view to its reservation and systematic management in National Forests. From 1902 to 1905, Olmsted was in charge of this work and was made Assistant Forester in 1903. This was without any doubt the most important single line of work undertaken by the government forest service because it laid the foundation for the present National Forest system. Olmsted had a genius for getting the best out of men working under his direction being chary of orders, guiding his subordinates rather than instructing them and making every man feel and accept full responsibility. It is to his clear visualization of the full scope of the duty of the government to preserve for posterity vast tracts of properly managed forest lands and to his ability to get his men over the ground that the country owes, in no small degree, its present National Forest system.

With the experience gained in the West during the days of boundary surveys, Olmsted was in a position to be one of the leaders in the Washington office when the Transfer Act of 1905 placed the National Forests under the newly created Forest Service, and his first work was to organize and build up an effective inspection system of which he was placed in charge as Chief Inspector of the Forest Service in 1906. Realizing that the real problems of administration were, in their essence, local problems, he began the fight against long-distance and centralized administration. The first step was gained with the creation of western inspection districts and Olmsted became Chief Inspector of the California District headquartered in San Francisco in 1907. His battle was won the next year when the district administration system was inaugurated and he was made the first District Forester of the California district. He brought the district to a high state of efficiency during his three years' service as its directing head and resigned from the Forest Service in June, 1911.

Olmsted resigned from the Forest Service in order to get into the woods. His work had become more and more organizing and administrative in character and he was hungry for the woods and for silviculture. He went East and joined with Fisher and Bryant in Boston in a firm of consulting foresters. He worked in eastern hardwoods until a chance came in 1914 for him to set up for himself as a consulting forester in California. He organized the Tamalpais Fire Protective Association and was its directing head and was employed as forester by the Diamond Match Company to introduce and supervise conservative cutting on their California holdings.

Of late years, Olmsted devoted much of his time to writing. Every forester in the country has been stirred by the philippics from his pen against forest devastation on private timber lands. They were the thorn in the side of the slack thinker, the complacent and smug forester and the lumberman whose only ideal was dividends. Almost as thoroughly as Mr. Pinchot had done in the early days on the subject of national forestry, Olmsted woke up the country to the need of private forestry.

Professionally, Olmsted was an idealist and a liberal. He was the sworn enemy of political exigency and *laissez faire* in matters involving professional principles. In his mind the forest and its welfare and its perpetuation were what mattered—not what some Senator wanted or what some lumber company stood to lose. With his passing, the profession has lost one of its leaders but it will always be clearer-thinking and cleaner for what he contributed to it during his life.

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## THE DENDROCTONUS PROBLEMS

By F. C. CRAIGHEAD

*Entomologist, in Charge of Forest Insect Investigations, Bureau of Entomology, U. S. Department of Agriculture*

The development of forest entomology in the United States has passed through several distinct phases. The more important of these consisted of the biological and systematic studies directed by Dr. A. D. Hopkins whereby an enormous amount of valuable data have been accumulated and the more important insects have been described and classified. All of this was essential as a foundation for control and preventive measures. These studies showed beyond doubt that the bark-beetles of the genus *Dendroctonus* are among the most serious insect depredators of our forests.

Bark-beetle control projects were introduced along with these studies and have been vigorously prosecuted during the last few years. This work is largely an effort directed toward the conservation of mature stands of timber, which has been the leading issue in the past, and for some time to come will still be an important consideration in entomological activities, particularly in the West. With the growing recognition of the fact that our future timber supplies are to be had, not alone by conserving present stands, but by growing future crops, however, it is time to determine what consideration must be given to insects in the application of silvicultural methods, particularly with the object of preventing rather than of controlling outbreaks.

It is necessary to speak of the *Dendroctonus* problems in the plural. According to the habit of the species, their mode of attack and their aggressiveness they differ radically, and each of the more destructive species presents a distinct problem. It is absolutely impossible to make any broad generalizations for prevention or control of the genus as a

whole or even for any one of its species in different regions and in different forest types.

Several of the more important species are here discussed in some detail, something of what we already know regarding them being presented and plans for future investigations suggested.

#### THE WESTERN PINE BEETLE

The Western pine beetle (*Dendroctonus brevicomis* Lec.) is morphologically a close ally of the southeastern species, the Southern pine beetle. Its habits, however, differ radically in many important features. The trend of recent studies convinces the writer that it is primarily what might be called a facultative parasite and that only under favorable and rather definite conditions is it really aggressive.

Messrs. J. M. Miller, F. P. Keen, J. E. Patterson and H. L. Person have gone into considerable detail in their investigations of this insect, and large control projects have been conducted by the Forest Service in cooperation with the Bureau of Entomology. An enormous amount of information has been accumulated, much of it contradictory and apparently allowing few generalizations. The statements given here pertaining to this insect, its habits and control are largely based on the reports of these men.

*Relation of infestation to site.* Generally speaking, the Western pine beetle appears to prefer overmature, slow-growing, decadent trees, particularly those on the poorer sites. Further studies may, in fact, demonstrate that sites one and two are rarely subject to epidemics of this beetle. The yellow pine forests east of the Cascades and those in the Klamath Lakes region and in southern California are very susceptible, while such forests as the Stanislaus and Eldorado seem to be comparatively immune. In both the Klamath Lakes region and the Chiquito Basin the heaviest losses appear to the writer to have been on the poorest sites, and particularly was this true of 1924. Mr. Person is now devoting special attention to this phase of the problem, especially on timber sales areas where losses have been high.

Another characteristic of this beetle, indicating its inability to thrive on the better sites, has been observed by Mr. Miller. To quote him:

"In the case of *D. brevicomis* the sudden appearance of newly infested trees, either singly or in small groups all over the forest, usually indicates an incipient increase. When groups of from 10 to 50 infested trees occur it is an almost certain indication that the infesta-

tion is about to decline. At least I have been able to predict a decline upon this evidence with considerable success in several cases."

These larger groups are frequently on the better sites and among trees of more rapid growth. In these more vigorous trees Mr. Miller and Mr. Person have noted that during the period of attack a higher mortality of the insects occurs and subsequently a lower rate of emergence which probably account for the decline in the outbreak.

When the forests over the entire range of yellow pine in Oregon and California have been more carefully studied from the standpoint of beetle infestation and classed according to type and site, it is probable that much more definite conclusions can be reached in regard to this feature.

It is not intended to give the impression that this insect cannot kill thrifty trees, for it undoubtedly does so when favorable conditions have allowed an unusual increase in its numbers. Even the species of *Ips* which normally attack only dead trees will kill great quantities of living timber when favorable circumstances have increased their numbers sufficiently. An excellent example of this now exists in the Inyo National Forests following the windfall of 1921.

*Rate of growth of infested trees.* General observations indicate that the Western pine beetle normally attacks the more slowly growing trees, although measurements of a sufficient number of infested trees to verify this have not been compiled. Observations in the Chiquito Basin indicate that after trees have reached the age of approximately 120 years, the rate of growth decreases and continues to do so for some years, until they succumb to *brevicomis* attack. Maturity and slow growth are in a sense synonymous. From the standpoint of profitable rotation, however, maturity occurs many years before the age of extremely slow diameter increment when the trees become susceptible to attack. This would suggest that once an area is under management the adoption of a short rotation, and a cutting practice to encourage more rapid growth, would largely prevent losses from the beetle.

*Periodicity of epidemics.* Since 1914 Mr. Patterson has conducted an annual survey to determine the bark-beetle losses on the Rogue River watershed. Another area in the Klamath Lakes region has been similarly cruised since 1916, and Mr. Miller has kept records on forests adjacent to Northfork, Calif., since 1917. It is still too early to state if epidemics occur with a definite periodicity, though all indications are very suggestive that such is the case. Recently Mr. O. J. Hauge has

been studying these records to determine if there is any correlation with rainfall. The information already collected is very significant as well as the fact that the losses from the summer generation of 1924 are extremely high, following the general drought of the preceding winter and spring. Besides this periodicity, a sudden increase in infestation may take place within more local limits. Such was the case on the California National Forest. Here Mr. Miller found that, following a windfall in December, 1920, which included 15,000,000 board feet of yellow pine, the infestation throughout the surrounding region remained in a low "endemic" condition during the season of 1921, but that in the summer of 1922, the second season after the windfall, it suddenly increased 700 per cent. In 1923 it dropped back to normal, subsiding as suddenly as it had developed. Although the causes of this outbreak are obscure, subsequent studies by Mr. Person indicate that the quantity of beetles breeding in the fallen trees alone does not satisfactorily explain the sudden increase in 1922. Some combination of factors, including the breeding of beetles in the windfalls, and a temporary checking of the growth of the trees, seems to be the more reasonable explanation of the outbreak.

*Interrelation of infestation and forest fires.* It has been known for some time that fire-scorched trees offer a great attraction for this beetle. Invariably the infestation increases following a light burn, while at the same time it decreases in the surrounding forest. Mr. S. B. Show and Mr. E. F. Kotok of the Forest Service and Messrs. Patterson, Miller and Keen of the Bureau of Entomology have all collected definite figures illustrating this. Mr. Miller has noted that the year following such a concentration a sudden marked decrease in the number of infested trees occurs, due to the high mortality of the broods. If outbreaks occur during drought periods, the fires that are coincident will no doubt tend to check excessive multiplication of the beetles. This attraction and mortality of the beetles on burns suggest certain possibilities in developing more effective control operations.

*Conditions affecting brood development.* It is evident that an increase in the beetle population of any forest, excepting that resulting from flights, must come about through the development of a higher percentage of the brood. Considerable work has been done by our western forest entomologists in determining the ratio between the numbers of beetles attacking and the number of progeny emerging under various conditions. Much valuable information has been obtained but more is

needed before definite conclusions can be drawn. These studies and observations of brood development have shown that very definite conditions are necessary for maximum brood development. From felled trees, sawlogs and tops, a very low percentage of emergence occurs. Fire-scorched trees are rarely attacked if all the needles are burned off. When half the foliage is destroyed poor emergence results. Trees that are merely scorched on the lower stem afford more favorable conditions for development of the broods. "Black jacks" develop small broods. The emergence of the summer generations is always greater than that from the overwintering broods. Trees defoliated by the pine butterfly in central Idaho were being attacked by this beetle in the summer of 1924 but the beetles did not establish themselves. Trees attacked by the summer generation of 1924 at Klamath Falls, Oreg., showed an unusually high percentage of emergence. This all indicates not only that very definite requirements are necessary for normal brood development but that only under the most favorable conditions can actual increases occur. It also suggests that the water content or sap concentration of the phloem is the critical factor. In all cases where high mortality of the beetle occurs, either excessive moisture or desiccation obtains. Mr. Patterson and Mr. W. D. Edmonston have shown that it is possible to induce attack on living trees by caging infested bark at their bases. These beetles in attacking produce an attraction and others concentrate above and kill the tree. These experiments did not prove successful on all trees tested, however, indicating that other factors were operating. These studies also showed a very high mortality of the beetles during the initial period of attack. Systematic experimental studies with felled, girdled, fire-scorched and defoliated trees, as well as with trees treated to produce conditions simulating drought and excess moisture, are necessary in order to obtain further information on these problems.

*Results of control work.* During the last 15 years the Forest Service, cooperating with the Bureau of Entomology, has conducted a great amount of control work. Messrs. Ralph Hopping, Miller, Keen and Patterson have directed the entomological features and analyzed the results. Approximately \$300,000 has been spent in the treatment of 75 million feet of infested timber. First, the percentage theory of control was advocated and tested; later the treatment of all infested trees was attempted, and finally, this thorough initial work was followed up by maintenance control. Some projects gave excellent results the following year, though, in a few instances, an increase in infestation occurred.

The great disparity in the results obtained certainly indicates that some other factors have more effect on the infestation than direct control operations.

The theory that killing the broods in a large percentage of the trees will reduce the infestation to just such an extent sounds reasonable. It does not, however, take into consideration the fact that under favorable conditions these insects have extraordinary powers of multiplication and that under these same conditions possibly fewer beetles are required to overcome the resistance of the tree. Even with the most carefully executed work it is rarely possible to treat more than 80 per cent of the infestation. The other 20 per cent, under optimum conditions for attack and development, might readily offset such a reduction. For some time Mr. Miller has been doubtful of the effectiveness of this method of fighting the Western pine beetle. He has stated his objections as follows: (1) This type of control work is expensive; (2) uniformly successful results have not been secured, and (3) the results are not permanent.

One feature of a large experimental project in the Sierra National Forest was an attempt to exterminate the beetles on a unit of 3,600 acres by keeping up a continual patrol and treating all trees as soon as they could be located after attack. After three seasons of this intensive work the loss in 1924 was higher than in preceding years, but many of the dying trees contained very few beetles. The flathead (*Melanophila*) was more in evidence than *brevicornis*. These results seem to suggest that the trees continued to die even though an actual reduction in the beetle population was brought about by persistent control.

The large Klamath Lakes control project directed by Mr. Keen has shown some peculiar discrepancies. The reduction following control bears no correlation to the percentage of infestation treated, and the summer infestation of 1924 has exceeded that of previous years even on some areas where the most intensive work was done. Fall control work on this project gave uniformly better results than spring work, although the latter was just as thoroughly carried out. A partial explanation may be that the late burning just before the spring flight attracted beetles from surrounding territory. It is well known that the treatment of trees infested by the Southern pine beetle during or just previous to the flight results in a concentrated attack about that point.

*Future investigations.* In an attempt to generalize from all the evidence that has been collected, the theory is advanced that the Western

pine beetle is primarily adapted to killing overmature or weakened trees, that trees on the poorer sites are particularly susceptible, and that the beetles' ability to increase in numbers is conditioned by physiological changes in the trees brought about by deficiency in rainfall or opening of the stand which allows greater desiccation. In other words, it is dependent on the exact condition of the host. It may even be possible that the insect is not killing more than the annual increment of the forest, when large areas are considered over 10 or 20 year periods, and that we are attempting the impossible in striving to protect the old and decadent in entire opposition to Nature's methods. There is no doubt, however, that successful management of the western yellow pine is just as intimately tied up with this beetle problem as it is with fire or with the silvical characteristics of the tree.

It is clearly evident that future progress in the application of preventive and control measures is dependent on the determination of the relation of these killings to the annual increment, and on a determination of the conditions responsible for an increase in the beetle population. Many of the preceding statements also need more data to substantiate or disprove them.

It seems that it will be best to select one or two large areas, such as the Chiquito Basin, and concentrate all major investigations there. Such a plan will permit a more thorough comprehension of all the interrelated factors. The necessary modification of the results secured here for application to other forests should not be difficult.

*Substitutes for control.* Should the theories here advanced prove to be substantially correct, abandonment of control work will be necessary except in special cases. The bark-beetle activities on areas which will be inaccessible for many years can be regarded as a less serious menace. Management plans in accessible timber will require certain modifications based on a consideration of the insect factor. Such consideration will not affect better sites such as I and II. On the poorer sites clear cutting should be practiced or a smaller reserve should be left and these trees should be the most vigorous in the stand. This practice may necessitate first a preliminary light cutting to establish reproduction. Clear cutting by narrow strips or small groups, which is in effect the practice of this beetle, may solve both the problem of losses to the reserve stand and that of the establishment of reproduction. Continuous logging operations which will require smaller working circles will be a great help. Slash disposal will not be necessary from the standpoint of this insect.

## THE BLACK HILLS BEETLE

The Black Hills beetle is probably the most aggressive of all the species of the genus. A few days' observation of an outbreak of this insect will convince the most skeptical that it makes no discrimination as to the character of trees it attacks, preferring, if anything, thrifty second growth, though large mature trees are readily acceptable. Attacked in the fall, the tree dies slowly, owing to the perpendicular egg tunnels and the slow extension of the transverse larval mines, which do not completely destroy the phloem until late the following spring.

During "epidemic" status the infestation occurs in groups which are enlarged from a center, the emerging beetles attacking all adjacent trees with almost no discrimination excepting possibly the smaller suppressed trees and the old, overmature trees at the edge of the forest. These groups frequently coalesce or become of such a size that the living timber on entire sections or even several adjacent sections is practically wiped out. It is not unusual for the adults emerging from a large group to migrate suddenly, probably some little distance. On the Dixie National Forest an infestation was estimated at approximately 1,000 trees per section in 1922. Apparently a good emergence took place in 1923 but the new attack did not much exceed 50 trees per section.

Measurements on the Kaibab National Forest showed that trees making remarkably fast or extremely slow growth were equally susceptible, provided they were within the range of attack. Further evidence of the trees' vigor is indicated by the large pitch tubes. All observations indicate that this beetle requires living trees in order successfully to develop the new brood. However, it readily attacks felled trees and various trap trees. Preliminary experiments indicate that an excess of moisture or rapid drying produces high mortality; also, that the limits of optimum conditions for brood development are much more restricted than with the Western pine beetle. Little is known as to whether there is any relation between outbreaks and weather conditions. There is apparently no attraction to fire-scorched trees.

Under endemic conditions the losses from this beetle are practically negligible. The infestation is then well scattered through the forest, old mature trees of slow growth, suppressed trees and especially those struck by lightning being selected.

*Control operations.* With a beetle of this extremely aggressive type, where ability to kill trees depends entirely on numbers and mass attack, direct control measures should be highly effective. This has been

amply demonstrated on the Kaibab National Forest by recent operations directed by Mr. Keen and Mr. W. D. Edmonston and there are even more promising possibilities which are still in the experimental stage. Owing to the restricted conditions necessary for optimum brood development it seems possible that effective control measures for this beetle will require merely felling the trees shortly after attack. Such procedure would permit control work to be conducted during the fall and winter months when other duties in the forests are less pressing. In addition, by systematic surveys, a small crew could locate and treat incipient infestations before they assumed alarming proportions. Mr. Edmonston's observations in Colorado and recent examinations in the Dixie, Powell and Kaibab Forests suggest that it is possible to prevent epidemics by a limited amount of logging, well scattered through the forests. This is due to the attraction felled logs have for this species and the inability of broods to develop normally under the condition obtaining in these logs.

*Future investigations.* The Kaibab National Forest offers an excellent area and an unusual opportunity for continued investigations of the Black Hills beetle. The past outbreaks (referred to later) should be accurately dated and estimates made of the losses from the more recent killings. Studies of the development and growth characteristics of new stands replacing those killed by the beetle will undoubtedly give valuable information that can be utilized in the formulation of plans of management. Further biological studies of the beetle and experiments with trap trees and felled and girdled trees will add greatly to our knowledge of the conditions favorable and unfavorable to brood development and make possible more practical and economical control methods.

#### THE MOUNTAIN PINE BEETLE

In many respects the mountain pine beetle resembles the Black Hills beetle. Its ability to kill entire stands of lodgepole pine, white pine, and occasionally yellow pine, has been amply demonstrated by several long continued and extensive outbreaks. The epidemic in northern Idaho and Montana, which began about 1909 and still shows no abatement, even surpasses for continuity of activities any records we have of the Black Hills beetle. However, a decided preference is shown for mature timber and it is doubtful if an epidemic can really develop in any other than a fully mature stand. Lodgepole pine occurring in a mixed type is particularly susceptible after the intolerant species become dominant. Rarely are trees under 8 inches in diameter attacked.

In the sugar pine belt of California this insect acts in an entirely different manner, as though it might be really another species. The attack is more scattered, and is confined chiefly to the larger, probably overmature trees, resembling in many respects that of the Western pine beetle.

Our present knowledge of the bionomics of this beetle indicates that it differs little from the Black Hills beetle. It is very exacting in requirements for brood development, is particularly susceptible to drying of the bark, and in the lodgepole pine of the northern Rockies little emergence takes place in that portion of the tree above the snow line. It is not easily attracted to trap trees except large, thick-barked white pine logs, though fire-scorched trees seem to offer more attraction than in the case of the Black Hills beetle.

The possibilities of control by drying the bark of infested trees have already been tested in a series of felling and girdling experiments during August and September, 1924. The results will not be ascertainable until later.

The susceptibility of mature timber seems to offer some hope that increased utilization, to the extent that is now possible in certain forests of District One, will produce conditions unfavorable to epidemics of this species.

#### THE SOUTHERN PINE BEETLE

From the standpoint of aggressiveness and ability to destroy thrifty timber the Southern pine beetle is a close rival of the Black Hills beetle. When, however, we consider that it is at present attacking chiefly second growth stands, timber of a high stumpage value, its depredations are far more serious. This species differs from all others in its decided periodicity. It is either abundant, working in groups, and destroying up to 50 per cent of the trees over wide areas, or, in the years between, so rare that it is difficult or impossible to find specimens. Having from three to six generations annually when conditions are favorable, it multiplies with phenomenal rapidity and then disappears just as suddenly. These outbreaks occur during drought periods or whenever an inch or more deficiency in precipitation occurs during the growing season. Outbreaks start in groups on ridges of southern exposures, and rapidly spread. The new generations emerging from the dead trees show the same habit as the Black Hills beetle of migrating some little distance to start a new group of infested trees. Stands under 25 years of age are rarely attacked.

As far as we know this beetle does not breed in slash or felled trees. How it reacts to trap, girdled, or fire-scorched trees, or just what constitute most favorable conditions for brood development is not definitely determined. It is evident, however, that some peculiarity of living tissue is necessary; and that some abnormal physiological condition resulting from drought, possibly increased sap density, is essential. This may be only a mechanical reduction in the water content of the phloem; for heavy rains following shortly after attack effectively kill all stages of the developing insects as well as the parent adults, apparently by a simple drowning process due to an excess of water. Because any cutting during the flight period in epidemic years forms a decided attraction, Dr. Hopkins has advocated curtailment of all control work or cutting during the summer season. Turpented trees seem no more susceptible than round trees.

*Control measures.* Direct control work seems effective to a certain degree, though the results of such work have not been critically compared with what has taken place on untreated areas. By frequent and close inspection of the forests during unusually dry periods, incipient outbreaks can be detected and early control work will possibly be of benefit. On the other hand, the almost uncanny ability of this insect to increase enormously makes one skeptical as to the effects of these methods and suggests the futility of such a weapon in combating the potent forces that appear to be at work.

*Future investigations.* The depredations of this insect during past years have clearly demonstrated that it is going to be a real menace to the growth of future stands of these Southern pines: shortleaf, loblolly, pitch, table mountain, Virginia, slash and, least of all, longleaf. There is, therefore, imperative need for further investigation of the dependence of the Southern pine beetle on drought conditions and efforts to ascertain how this condition affects the trees and the development of the broods.

Here again it seems essential to designate an area of considerable size (or, better, several smaller areas, because of the scattered occurrence of the timber) on which systematic annual surveys of the losses from this beetle may be conducted. The relation of incipient outbreaks to conditions of site should be noted, records of precipitation should be obtained, and continuous records should be made of the sap concentration of the phloem and the relation that this bears to precipitation.

Periodic girdling and felling of trees will furnish information on

the attraction which trees thus treated offer for this beetle, and, if attack is obtained, much of value on brood development may be learned.

The dates of old outbreaks can be determined by the pitch pockets on surviving trees and by the increased growth after liberation. This is particularly true of white pine and table mountain pine which are frequently attacked unsuccessfully. A study of weather conditions as shown in ring growth on an area where two or three outbreaks have occurred might supply much valuable information.

There is also a need for more exact observations of the part played by this beetle in reducing the stands of shortleaf pine (the most susceptible tree to its attack) and thus encouraging inferior species of trees.

#### ENDEMIC AND EPIDEMIC STATUS OF INFESTATION

Forest entomologists speak of the bark-beetle conditions of any forest as "endemic," i. e., normal infestation, or "epidemic," the latter indicating that the insects are killing higher percentages of timber and are really aggressive. Miller defines a normal condition of the Western pine beetle in southern California as an infestation of 30 or less trees per section while Keen has been working in northern California and Oregon on the basis of 50. With the Black Hills and mountain pine beetles similar variations may occur in different regions, while with the Southern pine beetle infested trees are practically impossible to find between epidemic periods. This distinction between an endemic and epidemic infestation is thus difficult of exact definition. What is far more important is to be able to tell from the character of an endemic infestation when it will become epidemic and destroy large quantities of timber and again when the outbreak will subside. This problem needs thorough investigation, for on the proper interpretation of existing conditions rests the entomological basis for control recommendations. The recent sudden decline of the Black Hills beetle on the Dixie National Forest and repeated cases of sudden disappearance of the Southern pine beetle emphasize the pertinence of this question.

Systematic observations, by strip surveys and comparison of the annual losses of several years, are at present the only safe guides for recognizing a dangerous status of these insects.

#### DENDROCTONUS BEETLES AS SILVICULTURAL AGENTS

Foresters fully recognize the silvicultural effects of fire, yet few realize that insects are just as important agents in the development of

our forests, or even more so. [The writer has called attention to the interrelation of fires and the spruce budworm in the development of our Northeastern spruce and fir forests. The *Dendroctonus* beetles likewise are important agents.

The history of the Kaibab Forest is essentially that of the Black Hills beetle, supplemented by local fires. Over the entire Buckskin Mountain old killings are in evidence, the trunks prostrate on the ground. Many of these are as large as the present killing. They can be accurately dated by the evidence of accelerated growth in suppressed trees which escaped and by the characteristic pitch pockets produced in unsuccessfully attacked trees. One tree 400 years old showed seven unsuccessful attacks. Thus, in this forest the killing has been more or less continuous although probably with cycles of greater severity. In other words, this densely stocked, immature, yellow pine forest has been produced by these beetles. They have been putting in effect a form of management, cutting by a group system the annual increment. Little study is needed to demonstrate that it has been a highly successful system, probably producing a maximum yield on a relatively short rotation. It would not be surprising if further investigation should show this period of rotation in this forest to be under 100 years. One objection to this practice of the beetle is that rarely have the trees on areas of any size been allowed to mature. Fires on the Kaibab Forest have been local affairs starting from lightning. A fire in 1922 in green timber did little damage except to the smallest reproduction. Past fires in "bug-killed" centers with much inflammable debris on the ground have been more severe, killing the reproduction and changing the pine to an aspen type. Here pine will become established very slowly. The Wylie Point Plateau once contained an excellent stand of pine, as evidenced by the dead trees now on the ground and a small remaining block of standing green timber, but this is now largely an aspen forest beneath a scattering of scrubby pines. In the mixed type fires are more severe and are followed by dense stands of aspen through which pine gradually pushes its way and later spruce and fir. The beetles finally take nearly all the pine, leaving practically a pure fir and spruce stand.

On the Powell and Dixie Forests the history has been much the same. Here, however, we have a much poorer quality of timber, the trees being shorter and more scattered. It is not entirely improbable that beetles have been taking a heavier toll on these forests and may be responsible for the poorer condition of the timber, although possibly aided by a naturally poorer site and less favorable conditions for growths.

In the northern Rockies the mountain pine beetle is rapidly converting the mixed type of lodgepole, fir, and spruce into a stand of tolerant trees. When lodgepole occurs pure the openings resulting from the work of these beetles are seeded again with lodgepole pine and the history is much the same as that resulting from fire, although, as the smaller trees are not acceptable to the beetles, a two-aged forest results. The intensive fire protection of overmature lodgepole pine stands is not improbably producing a condition favorable to widespread epidemics of the mountain pine beetle.

The characteristic age grouping of the Western yellow pine of the Pacific coast is almost undoubtedly a result of the group-killing system of *Dendroctonus brevicornis*. In the yellow pine-Douglas fir type the destruction by this beetle is reported to be much less serious. The Douglas fir beetle takes its toll of overmature firs just as the mountain pine beetle does in sugar pine when this tree occurs in the mixture. There is much to suggest that these beetles play an important role in maintaining these mixed types of intolerant pines and tolerant firs. In the northern Rocky Mountains the spruce budworm also aids in removing the tolerant firs.

The Eastern spruce bark-beetle (*Dendroctonus piccaperda* Hopk.) formerly took a considerable toll of overmature spruce. In such openings the percentage of fir rapidly increased, producing a favorable mixture for budworm activities and consequent lowering of the percentage of fir. In these forests fires bring in poplar and birch and a longer period intervenes before the conifers are attacked.

From the older accounts of the abundance of shortleaf pine on many of the southern slopes in the Piedmont region there can be no doubt that the Southern pine beetle has been a cofactor with lumbering and fires in producing a greater preponderance of oaks and inferior pines. Hopkins refers to this condition in Bulletin 56 of the West Virginia Agricultural Experiment Station.

There are many lessons to be gained from a detailed and systematic study of the silvicultural effects produced by these beetles in developing the present stands and in the conversion of temporary types of forest to permanent types. Present plans of management which do not take into consideration the *Dendroctonus* factor may produce conditions favorable for a serious loss from later outbreaks.

I have attempted to present these problems of the *Dendroctonus* bark-beetles in such a light that they can be more readily appreciated

## CONCLUSION

by foresters, and to show that they are not purely entomological but essentially problems of silviculture and management. Their solution is just as essential in the production of future timber as is that of other problems of forest research. Such extremely complicated problems can be solved only by the cooperation of entomologists, foresters, and other specialists.

Rabbits, squirrels, porcupines, mice and birds all are receiving consideration in the forest complex, while the forester's attitude toward the most important of all the biotic factors, the insects, is frequently apathetic. The strictly entomological studies have been largely completed and it is now time to widen the scope of the investigation and to attack these problems from ecological and silvicultural standpoints. Constructive suggestions from the foresters, plant physiologists, and others having contact with these problems will be appreciated.

## A FOREST POLICY FOR THE NORTHWEST\*

By FRED MORRELL,

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It is, of course, impossible for one whose sphere of duties has been limited to a part, and at that a quite minor part, of the Northwest from the standpoint of timber production to discuss with any degree of intelligence the many factors which need consideration and regarding which there is such wide variation in the five Northwestern states, or to form any sort of structure, even as something to shoot at, that might be called a proposed logical forest policy for the Northwest. It is believed that the experience of other men who have given study to the subject would check with my own which is that if one should have the temerity to think today that he knew for certain what should be done about any one phase of the problem, as applied to even one state, he would learn something tomorrow that would upset or at least shake his conclusion. At any rate, the writer feels that the most he can do is to discuss in a very meager way some of the theories that enter into the problem and to sketch out in a very tentative manner some of the things that look as though they might be done. The most fitting observation perhaps is that not enough is known at this time of present conditions—let alone future conditions—to make any plan. The trouble with that is if something is to be done, the observation does not answer as a basis for action.

The statistics compiled for the Reforestation Committee hearings show that there is a present virgin stand of timber in the five states of slightly over 1,100,000,000 board feet. The present virgin timber area is given as 78,460,000 acres and the total forest land area as slightly over 100,000,000 acres. Fifty-five per cent of the timber is owned by private interests and private interests own 30% of the land. Of the 45% of timber owned by the public, 3% is state and 42% is federal. And of the 70% of publicly owned forest lands 2½% is state and 67½% is federal. Since it is expected that the bulk of the virgin timber will be cut within a generation, I have been able to see no good reason for any policy which would attempt to change materially the form of ownership of the virgin timber. There seems no sound basis for the assumption that the virgin timber would be enough, if any, better protected in public rather than in private ownership to warrant material

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\*Address given before joint meeting of Society of American Foresters and Forest School of University, March 5, 1924.

change. And while silvicultural measures could be more readily applied if the land and timber were in public ownership, it would seem as easy to enforce any desired practice on the private owner as it would to secure transfer of ownership. As a practical proposition, therefore, I think it possible to put down the one point as a contribution toward proposed forest policy that any radical change in ownership of virgin timber lands from private to public ownership prior to the removal of the virgin timber should not be advocated. To make such change would involve us in many difficulties of taxation and integrity of private property that would not be warranted by any good that might come out of it.

If this point may be passed for the present, at least, we can go on to the question of what, if any, change in ownership should take place with reference to timber lands held for the purpose of future production of timber. I have sought, without much result, for some discussion by authorities on the subject that would serve as any secure foundation upon which to build a theory as to the proportion of timber land that should be owned by the public and in what political subdivision ownership should lie. I have also searched for an answer to the question out of the experience in Europe where the problem is an older one than here. Zon and Sparhawk give the percentage of publicly owned forest lands in Europe as 54%, leaving 46% privately owned. The variation in the different countries is, however, a very wide one, ranging from 90% public in Greece down to 1.7% public in Portugal. Two-thirds of the forests of the world are in public ownership. Generally speaking, there is a smaller proportion of forest lands in private ownership in the older countries where the policy of continuous reproduction is most firmly established. It is also generally true that the public forests usually are on the poorer lands and that public regulation of private forests is, with few exceptions, extended only to those classed as "Protection Forests." It is also pointed out by Zon and Sparhawk that Norway, France, Germany, Belgium, Italy and some other countries are taking forest lands back into public ownership, which is increasing the percentage of publicly owned forest lands at the expense of privately owned. Even if more definite conclusions might be drawn pointing to any definite plan which is operating or has operated in Europe or elsewhere in the determination of ownership, it would, of course not of necessity follow that such a plan would be adaptable to the United States or to the Northwest in particular. The conclusion, therefore, is

that the experience of other countries cannot be taken as a guide for what the United States is to do. Nevertheless, there are some facts out of the experience of older countries which may well be kept in mind by foresters in this country when they attempt to take a hand in shaping a National Forest policy. Briefly, they are: First, public regulation of private forest land perhaps nowhere has resulted in bringing about as good silvicultural practices as has been effected on publicly owned lands; Second, public regulation of private forest lands that is really effective has been extended in the older countries to only relatively small portions of privately owned lands; Third, as a general rule forest regulation has been most effective on forests sufficient in size to provide continuous production, that is a sustained yield, and the private owner with only enough forest land to furnish a portion of his needs has not usually got his timber lands on the basis of a sustained yield; Fourth, in countries where a serious effort over a long period of years has been made to place the forests of the nation on a sustained yield basis, the trend has been toward an increase in percentage of publicly-owned forests.

Next to the question of public versus private ownership comes that of the form of public ownership. Here again one gets little light from the European situation. There is nothing to indicate a definite policy as to municipal, community, state or national ownership. One gets the impression that the form of ownership has been dictated by factors other than a plan-wise scheme of ownership. Nevertheless, as soon as one attempts to outline any proposed forest policy for the Northwest, the question of municipal, state or federal ownership immediately comes up. How much of the publicly owned forests should each form of political subdivision own? Bearing in mind the fact that forest regulation has been most effective on areas large enough to afford a continuous operation and the fact that in the Northwest, at least for a long time to come, the most economical operation would in general be that which can be carried forward on a large scale, there would not seem to be much justification for extensive municipal ownership for the reason that very few municipalities would be large enough or wealthy enough to finance the ownership of very large tracts of timber.

Passing on to the question of state versus federal ownership, the Reforestation Committee data shows the following percentages in ownership of forest land:

Name of State	Private	State	Federal
California .....	35%	.5%	64.5%
Oregon .....	41%	.3%	58.7%
Washington .....	46%	7 %	47 %
Idaho .....	7%	3 %	90 %
Montana .....	19%	3 %	78 %

The most notable thing in state versus federal ownership is the fact that Washington has retained a large percentage of its forest lands while California and Oregon have disposed of all of theirs. Possibly the forest lands originally owned by the state of Washington were more valuable as a state forest property to be retained than were those of any of the other states although Oregon and California would seemingly have had state property originally nearly as valuable. There was probably, therefore, nothing in this which indicates more than a different policy dictated by different points of view on the part of those in control of the state machinery. The states of Idaho and Montana have disposed of a larger proportion of their forest lands than has the state of Washington, and one may reasonably guess that there has been some sound basis in this disposition from the States' standpoint, that is, that much of the land originally owned by the States had only a future value and that the States having large acreage, small population and much undeveloped territory found it necessary to dispose of lands not immediately valuable for forestry purposes in order to raise money for current expenses. But the real question is "What should be the future proportion of state and of federal ownership?" and this question seems to swing inevitably back to the old and dependable source of debate "State Rights." There are doubtless some areas of cut-over lands in the Northwest which if acquired now would show good returns on the investment within the next 50 years. The percentage that such areas bear to the total of cut-over lands is, however, probably small. Where the lands are sufficiently productive to pay carrying charges plus taxes and interest, they would presumably be acquired by private interests. Lands which are productive enough to pay carrying charges but not taxes will presumably not be acquired or retained by private interest and they must therefore be under some form of public ownership. If they will not pay dividends either in form of taxes or in form of returns from stumpage when the crop is harvested then the State would be better off from the standpoint of financial advantage if the lands are owned by the Federal Government because the advantages accruing to the State through the

manufacturing of wood products would be just as big as though the State owned the stumpage and the Federal Government would be carrying the deficit. But there are certain advantages from governmental standpoint of the local government controlling natural resources within the confines of its jurisdiction and being able therefore to manage the resources in such manner as in the judgment of local authorities is best adapted to the needs of a community. In my own judgment these advantages are not sufficient to warrant the States voluntarily assuming ownership of forest lands which must be managed at a loss when measured by stumpage values if the Federal Government will take over the burden. The question of what is a fair share of the burden for the states to carry and what a fair share for the Federal Government to carry, of course is one for consideration. Whether or not the financial situation in California, Washington and Oregon is such that the nation should expect these states to carry a considerable proportion of such land is one on which I have not sufficient information to offer opinion. It would seem, however, that California at least might be expected to increase its ownership of forest lands which may not offer opportunity for financial advantage during the next generation or so. Possibly, Oregon might be expected to do likewise. So far as Idaho and Montana are concerned I do not believe that these states should be expected by the Federal Government to carry much, if any, of such land, and since there is probably very little cut-over land in either state on which a profit can be forecasted within 25 or 30 years, their acreage should probably not be increased, but if any change is made it should probably be in the form of a decrease in acreage even though cut-over lands might be acquired which a long time hence, say in 100 years, would show a profit. It is not believed that these states are in good enough position financially to make such an investment at this time.

Now to come back to the question of public ownership in any form versus private ownership. Is there anything to indicate what percentage of the land should be in private ownership? I have found just one principle which seems to have merit that will possibly help to some extent and that is that industries dependent on timber for the carrying on of their operations do well to own their timberlands in order that they may be assured of a continuous supply of a material which is needed in their operations. By industries I do not mean sawmill industries or pulp industries which are intermediaries between the stump and the consumer but industries such as the railroad industry, the steel industry, the automobile manufacturer, etc., which are engaged not in manufac-

turing lumber but in using it and which must have a supply of timber in order to carry on the industry itself. I have been unable to find anywhere a statement showing the percentage of timber used by such industries but it is apparent that at present, or for a long time to come, industries such as these which are located in the Northwest itself would need only a small portion of the forest land, and it hardly seems practicable for industries located in the far East or the middle West to own and operate forest properties in the Northwest. It does not, therefore, seem worth while to advocate very strongly private ownership of timber lands in the Northwest on this basis. It seems clear that there is a considerable acreage in California and the coast fir region and possibly a small acreage in the Inland Empire sufficiently productive to warrant acquisition or retention by private ownership under the present taxation conditions. There is no data at hand on which to hazard even a guess as to what proportion of the 30% of total forest land area in the Northwest, which is privately owned, might come within this class. Possibly not more than a third of it would and if so that would mean that not more than 10% of the total forest acreage would permanently remain in private ownership unless some subsidy in the form of reduced taxation, or assistance in protection costs, or both, is offered. If this figure might be taken merely for purpose of speculation, that would leave 20% of the forest acreage that would ultimately go on the tax rolls unless public assistance is offered or unless, for reasons other than the productivity of the particular land itself, the private owner continues to hold it. There is operating at the present time an urgent other reason why the private owner does continue to hold it and that is that in counties which derive a large portion of their income from taxation of timber, timber lands and improvements maintained for lumber production, the private owner feels that he must contribute a certain proportion of the cost of government in any event, and if he allows his cut-over land to go on the tax rolls that will not operate to reduce materially his taxes and he, therefore, holds the land because it is in the end costing him little to do so and he does not see any way of getting out of the necessity of carrying the cut-over land at a loss. If he proceeds, however, to remove his valuable timber he will presumably proceed to let go of cut-over land which is a liability rather than an asset. Operating against that tendency will be the fact that if he holds his cut-over land and protects it until such time as he has removed sufficient of his virgin timber that he will feel it desirable to let go of the cut-over land some of the cut-over land will by that time have grown into values which will warrant him in

retaining it. It does not seem likely, however, that the private owner will see enough value in cut-over land but that he will let go of a good share of it just as soon as he feels that he can do so and materially reduce the total taxes which he is required to pay. If a third or a half of the privately owned acreage should be retained by private owners and permanently retained because of the value the land will have by the time he can let go, as described above, it might seem at first blush that the question of cut-over private lands might not be of great importance but it must be remembered that on the 30% of the total acreage which is owned by the private interests is 55% of the total merchantable timber and it may be assumed just roughly that the 30% of acreage privately owned is capable of producing as much or more timber than the 70% which is publicly owned. It is also true that the privately owned land is much more accessible and that the stumpage will have a much higher value. Therefore, what happens to the cut-over private land is a very big factor in the solution of a permanent timber supply.

It is generally conceded, I think, that public assistance in some form or other is going to be necessary if cut-over lands of the Northwest are kept productive. The usual debate hinges not on whether or not public assistance is necessary but on the form of public assistance which is most desirable. Lumbermen generally hold that public ownership of cut-over lands, which do not offer returns within a period of 25 or 30 years, is the only practicable solution of the problem. The majority of foresters, I think, are much of the same opinion. Before venturing an opinion on the point, it may be well to analyze somewhat the situation that the private owners, the taxing authorities and the Federal Government are in at the present time. At the outset it may be said that the situation is quite unsatisfactory from the standpoint of all three. The private owner is faced with the problem of not knowing very definitely what the land will produce, how much risk he is taking of loss by fire or insects, being unable to forecast what his product will be worth when ready for the axe, what he is going to be called upon to pay in the form of taxes during the long years that it will take to produce a crop and how much public assistance he will receive in producing it. Even if he can see a profit sufficiently large to warrant him in taking the risks from loss and speculating on the value of his product when ready for market, he does not know but that he may be called upon to pay continually increasing taxes which will serve to wipe out any possibility of profit. The county and the state have no way of knowing what the private owner

will do with his property and therefore can not tell how much income in the form of taxation they may expect to receive if private ownership is encouraged. The Federal Government knows no more, if as much, regarding what will happen to the land and whether or not contributions from the public treasury may ever come back. It has no contract with a private owner which will insure his handling the land in such way as to produce a valuable crop and has no way whatever of controlling local tax authorities from imposing a duty on the land which will defeat any plans which either the private owner or the Federal Government may have. Obviously, I think, the situation is such that neither of the parties in interest is warranted in going very far in investing money in a venture that can not be consummated for a long period of years and that some arrangements in the form of contractual relations must be made before permanent progress can be expected or before money invested can be considered as any better than mere "wild-catting." There should obviously be some arrangement made that will guarantee to each party some reasonably definite procedure that will be followed out at least until the first crop can be harvested from cut-over lands. The simplest method would doubtless be for the public to take over the ownership of cut-over land, manage it as it saw fit and take directly whatever profit or loss might come out of it.

The five states concerned are using only a minor part of the timber which is now being cut within their borders. Increase in population in the last twenty years has been about 110%. Without going into the question of forecasting what the future demands for lumber within the five states themselves will be, it seems a reasonable assumption that there should be more timber for export than is used within the states if the cut-over land is put and kept in productive shape. If this is true, it would seem to be more a national than a state question and this again would point to the desirability of federal rather than state ownership. There are many, however, who have believed, and the writer has been one of them, that private ownership should be encouraged and that it would be undesirable to have all of the forest lands pass into public ownership, but to bring about an assurance of private ownership in large measure it would seem necessary to have constitutional amendment and legislative action which would make possible definite agreements between the private owner, the county, state and the Federal Government, which would last at least until the end of the first rotation. If that could be done, the

writer believes that it would be desirable to continue in private ownership possibly two-thirds of the forest acreage which is now so held. The other third might, because of low productivity, or value for other purposes, better pass into public ownership. If it is not possible to bring about legislative action that will guarantee some permanent plan, it would seem better for the Federal Government to make its contribution toward forestry in the Northwest in the form of acquiring cut-over lands and proceed to manage the lands as it thinks best, rather than to continue to invest much money in the form of Weeks Law co-operation, which it has no assurance at all will be returned in the form of ultimate production of timber. The money now being invested in form of co-operative fire protection would go quite a long way toward the acquisition of lands as they are cut over and the private owner would, in many instances, probably be willing to forego assistance in fire protection if the Government would take off his hands the cut-over land problem. The Federal Government, owning a great deal of land, would be in better position to assist the local communities by distribution of receipts and could contribute more towards stability of local government than would be possible in most instances if the cut-over land is held by private individuals.

It may be properly pointed out that form of ownership may be considered as a flexible matter and that percentage of land in one form at a given time may properly change as conditions change so that after all the biggest consideration is not who owns the land at the present time but how to get it in productive shape. If it develops later that it would be better to have the ownership changed, that may perhaps be expected to work itself out as economic and political conditions change.

#### SUMMARY

1. There should be a classification of forest lands, both virgin and cut-over, by a public agency headed by the Federal Government and in co-operation with committees of owners and local political authorities, this classification to determine what lands should remain in forest production and their approximate productive capacity. This would lay the ground-work for some definite agreement between the private owners, local authorities and the Federal Government for carrying out a definite plan of forest production on the acreas owned by the various private interests and on which to base also a plan for permanent ownership.

2. No considerable transfer in ownership of virgin timber land is considered desirable.

3. Municipal ownership of timber land in any considerable extent is not considered desirable.

4. State ownership to be extended in California and Oregon, not to be extended in Idaho and Montana, which states should probably release some of the lands now held.

5. Federal and State legislation should be enacted which would provide for three-cornered agreements where public assistance is to be given private owners, either through remission of taxes or otherwise, and public assistance should in the main be limited to areas on which such agreements are made, agreements to be over a period long enough at least to produce a second crop of timber from cut-over lands.

6. Private ownership of cut-over land should probably be in the neighborhood of 20% of the total forest land area held for future forest production, this being the more productive land.

7. There should be an extension of Government ownership over the less productive cut-over land.

8. Policy should contemplate change in ownership as economic or political conditions warrant.

## FOREST CONFLAGRATIONS IN SIBERIA\*

With Special Reference to the Fires of 1915

By V. B. SHOSTAKOVITCH

*Magnetic-Meteorological Observatory at Irkutsk, Siberia*

Forest fires are very common in Siberia. Nobody is surprised to observe them, much less alarmed. In a few cases, only, the fires originate through lightning: mostly man is responsible for their appearance.

The forest fires of the second category are partly occasional, provoked by the careless treating of fire within the forests. They are very common during the second half of summer and early autumn, when the forests, filled with dry inflammable material, catch fire immediately from every occasional spark. Often fire is set intentionally by the local population. Dry grass and bushes are burned, usually in spring, on meadows where it is considered a good way to ensure good grass in summer. Siberian natives are doing the same within the taiga to prepare good meadows for the wild animals upon the hunting of which many of them are entirely dependent. To prepare a field within the taiga it is always necessary to destroy a lot of forest and burn most of the trees. In all these cases fire often gets beyond control, becoming immediately disastrous, the sparse Siberian population being absolutely powerless, and the fires, spreading out hundreds and thousands of miles, are stopped only by natural agencies. Such fires being repeated from year to year, most of the new Russian settlements within the taiga are surrounded with burned out forests. This sad picture is to be observed over millions of acres.

In spite of the fact that the forest fires are so common in Siberia and so important in the economical life of that country, no attempt has been made yet to investigate scientifically this calamity and express in figures its amount. The present article attempts to do this for the year 1915, when the forest fires were unusually extensive, even for Siberia. The necessary material had been collected by the Magnetic-Meteorological Observatory of Irkutsk which, confronted with the widely spread out fires of 1915, had sent out 500 questionnaires, 350 of which came back properly answered. During the winter of 1916-1917 the data thus

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\*Translated from the Russian by Dr. Tolmachoff, Carnegie Museum, Pittsburgh, Pa.

collected were partly worked out by the members of the staff of the Observatory, A. Vosnesensky, J. Belyaëff, and the present writer. As the data collected and summarized by Vosnesensky are kept at the Observatory, the writer has decided to complete the work and publish the results.

Owing to the extremely dry spring and summer of 1915 in Siberia the forest fires, started as usual during spring, spread out unimpeded during the whole spring and summer.

The distribution of precipitation during the months of May-August, 1915, was very peculiar, as shown on the Table I, in which, for a number of localities, are given the real precipitation and the percentage of the normal quantity.

TABLE I  
PRECIPITATION IN SIBERIA, 1915

Station	Latitude	Longitude East	Percentage of a Normal Quantity of Precipitations			
			May	June	July	August
Tobolsk.....	58° 12'	68° 14'	168	100	218	59
Omsk.....	54° 58'	73° 20'	130	132	114	48
Tomsk.....	56° 29'	84° 57'	150	31	79	14
Barnaul.....	53° 20'	83° 47'	142	137	117	165
Dudinka.....	69° 07'	87° 00'	108	44	2	29
Yeniseisk.....	58° 27'	92° 11'	148	26	56	25
Rybnoye.....	58° 08'	94° 28'	85	54	85	10
Experimental Farm at Kazachino....	57° 45'	93° 12'	61	100	32	30
Troitzkoye.....	57° 13'	94° 58'	88	77	85	15
Dolgy Most.....	56° 55'	96° 36'	60	129	9	3
Kansk.....	56° 12'	95° 39'	47	55	19	75
Krasnoyarsk.....	56° 01'	92° 49'	87	65	49	77
Leonidovsky Zavod.....	55° 24'	91° 49'	55	56	45	108
Minusinsk.....	53° 43'	91° 49'	103	109	30	92
Nijnaya Bulanka.....	53° 10'	92° 42'	127	100	70	60
Tolbuskaya.....	52° 21'	96° 02'	155	67	119	109
Viluisk.....	63° 45'	121° 35'	119	139	65	47
Kirensk.....	57° 47'	108° 27'	108	198	48	26
Omoloy.....	56° 28'	106° 16'	89	226	98	35
Bratsk.....	56° 04'	101° 50'	102	127	34	10
Tulun.....	54° 33'	100° 22'	79	79	44	31
Kharbatovskoye.....	53° 45'	106° 02'	190	52	49	52
Irkutsk.....	52° 16'	104° 19'	250	20	244	113
Tunka.....	51° 45'	102° 33'	182	203	258	96
Barguzin.....	53° 27'	109° 37'	86	17	90	73
Mysovaya.....	51° 43'	105° 52'	391	54	142	93
Verkhne-Udinsk.....	51° 49'	107° 35'	400	74	137	250

Within the region embraced in the Table I, over 1½ million square miles are included. This covers the eastern part of the government of Tobolsk; nearly the whole of the northern and eastern parts of the government of Tomsk; the whole government of Yeniseisk; the northern and western parts of the government of Irkutsk; and the south-western part of the government of Jakutsk. Precipitation over this whole area was much below normal. On the borders of this region pre-

precipitation was about 50-60 per cent of the normal, near the center of it hardly 30 per cent. Such a drought during summer in middle Siberia, as in 1915, is quite unusual. In the government of Yeniseisk, for instance, during 40 years, from 1871 up to date, there had been no summer like this of 1915.

The character of the drought is expressed more distinctly by Table II, where the rainless periods are given for a few points of middle Siberia, mostly in the government of Yeniseisk.

TABLE II  
THERE WAS NO RAIN

Station	June From	July Till	Number Days	July From	August Till	Number Days
Yeniseisk.....	16/VI	15/VII	28	28/VII	16/VIII	18
Rybnoye.....	16/VI	15/VII	28	28/VII	19/VIII	21
Choida.....	8/VI	15/VII	36	28/VII	14/VIII	16
Tomsk.....	7/VI	5/VII	27	25/VII	29/VIII	34
Experimental Farm at Kazachino..	24/VI	15/VII	20	28/VII	14/VIII	16
Krasnoyarsk.....	21/VI	20/VII	28	20/VII	15/VIII	25
Balakhta.....	14/VI	13/VII	28	..	..	..
Taishet.....	29/VI	18/VII	18	28/VII	15/VIII	17
Dolgy Most.....	22/VI	18/VII	25	28/VII	14/VIII	16
Jeptaky.....	18/VI	16/VII	27	27/VII	15/VIII	18
Chamanskoye.....	19/VI	11/VII	21	26/VII	16/VIII	20
Nijne-Udinsk.....	....	....	..	22/VII	15/VIII	23

There were two periods during the summer of 1915, when in middle Siberia there was absolutely no rain: the first one from middle June till middle July (18-36 days at different places in the table); the second one from the end of July till the middle of August, 16-34 days.

The forest fires correspond completely to the meteorological conditions referred to above. Starting during May, they were still increasing during the summer, attaining the greatest intensity in August, in some places already by July.

One hundred and forty-two answers from the number received by the Irkutsk Observatory pointed out the details of the distribution of fires during different parts of the summer. The most extensive fires, as thus indicated, were, for August, 52 per cent; for July, 31 per cent and for July-August, 17 per cent.

Distributing the last figure between July and August, two maximal periods of fires are expressed very distinctly: August, 61 per cent and July, 39 per cent, both corresponding completely to the two periods of drought mentioned above.

In many places in Siberia the fires persisted during the whole summer. The main continuity of fires, on the basis of the 142 observations,

was in June, 13 days; July, 20; August, 17; and September, 1. On an average during the three first months there were 50 days with fires, totaling about two months.

The fires took place between 52 and 70 North Latitude, and 69 and 112 Longitude, East, covering about 700,000 square miles, about one-fifth of the area of all Europe. Fires raged within these limits not without some interruption, through different causes, the most efficient of which, the large rivers, stopped the fires at once. Nevertheless huge portions of the forest were destroyed completely, e. g., between Angara River and Nijnya Tunguska; about half-way up the Ob River and its tributaries; and on the right shore of the lower Yenisey. In many answers received by the Observatory the area of forest destroyed by fire was given, the whole amount being about 55,000 square miles, equal to about one-third of western Europe (excluding Russia), this being about eight per cent of the whole region affected by fire.

The fires, according to Siberian terminology, were of the "upper type," when not only dry grass and brushwood, but, also, the trees burned. In many places peat burned, also. In the Kainsk district, government of Yeniseisk, fire remained, after the first spring fires, within the dry hillocks and, during summer, with the marshes dried out, peat fires started, in many places burning in different directions over six feet below the surface, without any possibility of being put out. Such fires took place near the towns of Mariinsk, Tomsk, and in many places in the government of Yeniseisk. In some places with sandy soils, the humus of the upper part of the soil was burned, exposing the sand, and the cultural parts of the country were rendered worthless at once.

Smoke development was extremely extensive, spreading widely beyond the limits of the fires, covering the region between 64.2 and 72 North Latitude and 61 and 133 East Longitude. All of middle Siberia was enveloped by smoke, sometimes so thick that it was not possible to discern through it trees, houses, etc., at a distance of 14 feet. On the basis of 300 questionnaires it was possible to establish three different degrees of intensity of smoke: 1. Continuous smoke, objects not perceptible through a distance of over 350 feet; 2. Nothing to be seen at a distance of 77-350 feet; 3. Nothing to be seen at a distance of 14-70 feet. Smoke covered altogether an area of 2,632,000 square miles, about equal to the surface of the whole of Europe. Smoke of the first category covered 1,097,000 square miles; that of the second

category, 833,000 square miles; that of the third, 702,000 square miles.

The presence of smoke completely coincided with the continuity of fires. In many places smoke was present during the whole summer, its average continuity being 51 days. The greatest density of smoke corresponded to the maximal development of fires. It was a great drawback to the regular routine of life within the region. Navigation on the rivers Ob, Tobol, Tom, Irtysh, Yenisey, Angara, and Lena was badly handicapped, even the steamers remaining idle for a while. Flotation of the rafts on the Irtysh River stopped at once. Communication with small boats was accomplished only with great delay. Part way up the Angara River, for instance, the river is the only way of communication, and boats were a fortnight making the trip between the villages of Rybnoye and Boguchan, the trip usually taking only six days. Fishing sometimes stopped on the rivers, also, the fishermen were afraid of being lost. Regular traffic on the railroads was interrupted, too, in some parts, as, for instance, between the towns of Mariinsk and Krasnoyarsk where signal lanterns were used sometimes both day and night. In Mariinsk, on July 30, a very heavy smoke, in connection with a few drops of rain, became so dense that, at three o'clock, day changed into night, provoking a real panic of fear among both people and animals. On the streets and in houses lights were made; the workmen stopped work and returned home; and cows ran bellowing from the pastures back to town. The work of traveling astronomers, connected with the surveying work, and topographers was sometimes extremely difficult. Very often topographers used a piece of wet cotton to protect the nose and mouth. A few cases of suffocated hunters were registered, too.

The influence of the smoke on vegetation was noticed by the people, who explained in this way the poor quality of the grain crop of 1915, checked against that at the experimental farm at Tulun. All the cereals, rye, wheat, oats and barley, had a vegetative period in 1915, 10-15 days longer than usual, although during a dry and hot summer, as in 1915, it is generally shortened. In this case the direct influence of the sunshine was decreased by the smoke screen. Grass and hay were covered with soot, thus acquiring a smoky smell and bitter taste, and sickness among the cattle resulted from the use of this fodder.

A decrease of sunshine was registered at the meteorological stations, the number of hours with sunshine being less in 1915 than normal, in all cases observed, as given in the following table:

TABLE III  
SUNSHINE IN SIBERIA, 1915

Station	Latitude	Longitude East	Hours With Sunshine			
			July		August	
			Observed	Normal	Observed	Normal
Jeptaki.....	57.7	98.4	217	250	134	208
Exper. Farm at Kazachino....	57.8	93.2	200	230	131	175
Ust Kalskoye.....	53.2	91.3	235	294	123	266
Tanguy.....	55.6	100.1	219	245	129	202
Bur.....	58.9	107.0	248	265	148	187
Jurievo.....	59.9	108.0	256	359	152	222
Average.....	....	....	229	273	136	210

In July, 1915, only 85 per cent, in August, 65 per cent, of normal sunshine was registered.

The influence of fires on the wild animals was extremely great. Even the birds were destroyed by the thousands, especially the young ones or those moulting. In many places bees disappeared at once, as did also other insects. The destruction of mammals was particularly noticeable. In the forests along the Angara River and within the government of Jakutsk the hunters later came across numerous charred remains of animals, or killed and caught squirrels, ermine, etc., with their tails burned. Animals migrated great distances, sometimes appearing in quite unexpected places. Bears and wolves appeared near Krasnoyarsk, and, in many other cases, bears were reported killed near dwellings. Moose swam across the Angara River separately and in herds, even in the presence of man. Many squirrels appeared in the gardens in the town of Mariinsk as well as in the gardens along the Siberian Railroad. During the fires, numerous squirrel corpses floated down the Yenisey, or squirrels, alive, were to be seen on floating trees, pieces of wood, etc. Many observers reported groups of bears, squirrels and snakes swimming across the large rivers, Chulym, Tym, even the Yenisey and Ob. Varieties of animals typical for some certain district of Siberia appeared in a new one, thus changing, at once, their geographical distribution. From the village of Esaulskoye up the Yenisey River it was reported, for instance, that it was possible on the same larch to meet with five or six different squirrel varieties: reddish; light-grey, typical for Kirensk district; dark-grey with black tail, known near Lake Baikal and within the government of Jakutsk; even a white variety like the ermine, altogether an association never known before. Long flights were made by birds: in the government of Yeniseisk the hunters came across the small variety of wood hen known before on the Lena River.

On the Zeya River some new birds were reported, unknown in that part of the country.

The economic loss from fires is enormous and can be appreciated approximately in the following way: the price of timber in Siberia on one acre is about \$20, and its amount 3,200 cubic feet. Supposing 50 per cent of the forest under fire were destroyed completely, then 27,500 square miles of forest would be burned, and 56,320,000,000 cubic feet of timber destroyed, with a value of \$352,000,000.

The other losses from such fires cannot be appreciated by figures like those given, but they are also very great: 1. The forest area is decreasing, especially through the repeated fires; 2. The most valuable slowly growing pine trees are replaced by birch, poplar, etc; 3. Forest territory, after a fire, often becomes marshy in the lowland, and sandy and stony desert on the hills and on the stony slopes. In both cases the amount of potentially agricultural land is decreasing very noticeably. A very interesting case of the latter result, due to fire, is known from the province Maritime of the Russian Far East.<sup>1</sup> During the sixties of the past century the valley of the river Avakumovka was occupied by peasant emigrants from European Russia. They had plenty of land for agriculture and the fine forests were inhabited by an abundance of different kinds of animals. Hunting became an important phase of the economic life, and, every spring, fire was set to drive game in a certain direction, or to provide pastures for it. In 40 years about 30 families of peasants have destroyed in this way over 1,000,000 acres of forest, with the result that, at about the time of the Russian-Japanese war, they were complaining of the lack of land. A revision and comparison of the surveys at different periods have led to the very interesting conclusion that the width of the flood-plains of the rivers and creeks has increased very noticeably, during the time referred to, due in all cases to the destruction of the forest. After the destruction of the forest, stones and sand were brought down from the bared tops, and the slopes became unsuitable for agriculture. The river Avakumovka was surveyed in 1902, and, about half way up, it was 210-280 feet wide. After the flood in 1907 it became 1120-1190 feet wide and, in the next year 1610-1820 feet wide, although the later flood was not higher than the previous ones.

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<sup>1</sup>O. Kuzeneva. Fires of Taiga in the Maritime Province. St. Petersburg, 1914 (in Russian).

## THE PLACE OF ENTOMOLOGY IN SILVICULTURE .

BY H. B. PEIRSON

*Forest Entomologist, Augusta, Maine*

To one who has traveled through the spruce forests of northern New England and eastern Canada and seen the appalling depredations created by insects, or who is at all acquainted with the tremendous damage which sawflies are doing to the larch and jack pine of the Lake States, or by bark beetles in the West and South, it seems wholly unnecessary to point out the very obvious place which protection from insects must take in future forest policies, and yet in spite of this widespread destruction, which, if caused by fire, would have been ample reason for a vast amount of publicity, many foresters still look upon these losses with serene indifference much as the ordinary man looks upon a spell of bad weather. It has been difficult to understand the reason for this apparent lack of interest when such tremendous enthusiasm has been shown for fire protection. It is not that insects do less damage than fire, but more probably because their attack is less spectacular, and is often not even realized by the average woodsman until the trees have been killed.

A review of the work done in forest entomology during the last quarter century indicates that very marked changes are taking place in the attitude of the public towards forest insect control work. We have passed through the basic stage of pure research where entomological efforts have been focused primarily on systematic and morphological studies, with somewhat superficial life history work, to the stage where economic application is being made the primary goal, without, however, losing sight of the fact that all control work must be preceded by detailed life history work.

Too much emphasis can not be placed upon the fact that the nature and amount of work done by forest entomologists depends almost entirely upon the demand for such work coming from foresters and timber land owners. The entomologist can not go ahead, raise funds, and put into effect control measures where there is no demand, regardless how serious the devastation may be. The economic work done in the past has, in every case, been the result of demands for such work, and the results obtained have, in nearly every case, proved of decided value.

The citation of a few examples will illustrate this point. The entomologist has shown that several insect pests, such as the locust borer and the two-lined chestnut borer, attack only trees whose trunks receive considerable sunlight. It is obvious that wherever planted, locust and chestnut trees should be grown in such a manner that the trunks will remain shaded, until they attain a diameter of approximately seven inches. A decided damper was put on the planting of white pine due to the ravages of the white pine weevil. An extensive study made of this insect brought out the fact that trees started at a density of 1,200 per acre on reasonably good sites will practically overcome weevil injury, due to the fact that the density of the stand causes the laterals to be forced into an upright position, one of them taking the place of the weeviled leader. Furthermore, it has been shown that pine coming up under the shade of hardwoods is almost free from weevil injury. It has been found that infestations of the poplar or aspen borer can be practically eliminated by cutting and burning the so-called "brood trees" from which infestations spread.

Recent demand for information on the desirability of burning slash from an entomological standpoint has brought forth the results showing that the greatest menace in slash is to be found in the stumps and large limbs and not in the smaller branches which are usually the portion of the tree destroyed in slash burning. At the present time, extensive bark beetle control work is being carried on in the West, from which remarkable results are being obtained. In the East the big problem has to do with the spruce budworm. This latter work is being financed entirely by timber land owners and gives every promise of results that will preclude further wide-spread destruction. The possibilities of controlling forest insects have hardly been conceived and there remains a vast amount of work to be done, the results of which will depend very largely upon the assistance received from the foresters.

The present trend of the entomology work is decidedly encouraging in that it aims not only to control insect outbreaks, but more particularly to prevent the outbreaks. Studies are at present being made both in the East and in the West to correlate insect outbreaks with weather conditions which may very well eventually result in the predicting of possible outbreaks several years in advance. The possibility of controlling incipient outbreaks of softwood defoliators by girdling is being tried in the East. In the Lake States interesting studies are being made in connection with sawfly epidemics. In the South the prevention

of insect damage to stored forest products has been receiving considerable attention.

There are two phases of the entomology work which at present deserve considerable attention. In the first place, there is a serious need of better entomology courses at our Forest Schools. Only two are at present giving adequate courses, and the lack of knowledge and appreciation of forest insect damage which many of the graduate foresters have, has been a decided handicap in the furtherance of forest entomology work. A graduate forester should have some knowledge of the more important forest insects and be able to recognize their work before it assumes epidemic form. With such training, our present system of fire patrol could well be utilized to assist in locating incipient insect outbreaks. Such a system has been tried with success in Maine during the last two years. As the men become better acquainted with the nature of insect outbreaks, the results will accordingly increase in value.

The second need is the putting of trained entomologists at our forest experiment stations. This promises to be the most important and far-reaching step yet taken. The solution of forest problems in the future will depend largely on methods of management and the advice and counsel of technical foresters will prove of utmost importance in formulating these methods. In a like manner, the entomologist can be of assistance to the forester, for planting programs and methods of management must take into consideration the entomological side. It seems futile to advise a man to plant certain species under certain conditions, or to manage certain types by certain methods, which, from a strictly silvicultural standpoint may be perfect, but which actually mean that the trees are doomed to be killed or seriously injured by insects. Oftentimes a slight variation in methods may be sufficient to forestall this danger. To many foresters the softwood reproduction coming in on budworm killed areas is extremely gratifying when in reality it is made up to a large extent of fir balsam which is merely inviting new outbreaks of the budworm. The extensive plea to plant white pine has been answered to such an extent in some sections that the trees are planted on even the poorest of sites and are consequently weeviled as soon as they get up above the grass. White pine is undoubtedly an excellent tree to plant under many conditions but there are limitations beyond which it is like throwing tinder on a fire. The cutting out of hardwoods to release the softwood growth has an entomological aspect which

should not be ignored. The hardwoods act as a veritable insurance against loss from insects to softwoods.

Looking into the future, I firmly believe that unlimited good will come from a closer association between men in varied lines interested in forest conservation. The problems are so tremendous and varied, and so little is actually known, it hardly seems as if we had any more than started in what is apparently the right way. However, I am firmly convinced that control of forest insects is just as practical as control of forest fires, and with the proper support the time is not far distant when the pioneer work of today will be superseded by the systematic prevention of future wide spread insect depredations. The secret of successful management of our forests of the future lies not in fire protection, in disease and insect eradication, in methods of cutting or planting, but in a combination of these factors in which each is given its just consideration.

## THE PLACE OF ENTOMOLOGY IN SILVICULTURE

*Comments on Mr. Peirson's Paper*

BY A. J. JAENICKE,

Mr. Peirson has shown that in the East the problems of forest insect protection can best be adequately met when such protection is made an integral part of forest management. This is equally true in the West for those timber lands which are now or very soon to be reached by the axe. By directing the earlier cuttings to the timber most susceptible to insect attack, and by leaving seed trees of the class and the species most resistant to primary insects, the Western forester can reduce present and future insect losses by forest management. Every close analysis of insect damage in the West brings added evidence that the forester and the forest entomologist must do their research work together if the growing need for effective insect protection is to be met quickly and effectively.

If, with the benefit of additional research, it is going to be easier to settle the insect problem in forests nearing utilization, what of the millions of acres of mature forests in the West which must have protection for decades to come? From time to time, beetle epidemics may so seriously threaten portions of such stands that good business practice calls for a prompt and vigorous control campaign. Western timber owners are becoming increasingly uneasy over their insect losses as their timber becomes more valuable. In numbers of cases the direct control methods developed by the federal Bureau of Entomology have proven eminently satisfactory, but there is full agreement among entomologists, as well as foresters, that marked improvement in existing control methods is both possible and necessary before such methods can be applied on a large scale with full assurance of ultimate success. That such improvement is possible only through cooperative effort on the part of foresters and entomologists is clear to the research men in both professions.

Western yellow pine (*Pinus ponderosa*), western white pine (*Pinus monticola*), sugar pine (*Pinus lambertiana*), and lodgepole pine (*Pinus contorta*) suffer tremendously from time to time through the epidemic activity of *Dendroctonus* beetles. In some of the larger epidemics, the beetle losses result in the killing of billions of feet of

thrifty timber. For example, in northern Montana, many thousands of acres of lodgepole and yellow pine are red with the foliage of trees killed by the mountain pine beetle. This infestation seriously threatens most of the valuable lodgepole in Montana. In northern Idaho, the western white pine stands have frequently had their volume quickly reduced to one-half by the work of the mountain pine beetle and the destroyer is still active. In British Columbia, almost \$100,000 has been spent during the past five years in an effort to put an end to rapid killing by the western pine beetle and the mountain pine beetle. In southern Oregon and northern California, the Federal Government and the private owners have spent \$200,000 in the last three years in a cooperative effort to stamp out a western pine beetle epidemic in a million acres. In this stand of yellow pine, *Dendroctonus* beetles have killed over one billion feet of pine in the last 10 years. The western hemlock looper defoliations in the Douglas fir of Western Oregon, the activity of the notorious spruce budworm in the forests of Idaho, the epidemic work of the Black Hills beetle in the yellow pine of northern Arizona—these are just a few additional insect problems which just now are giving concern to those who are responsible for the protection of the Western forests.

There is a real need for a better appreciation of the role of insect protection in Western forest practice on the part of foresters. It seems to me that this need can best be met by more attention to forest entomology in the Forest Schools and to joint consideration of forest insect problems by foresters and entomologists in planning and carrying on forest research. Much has already been accomplished in placing effective forest insect control on a firm basis, but as time goes on, there is a clearer realization that the difficulties and uncertainties still ahead can be removed only by the cooperative effort of foresters and entomologists.

# FORESTRY ON ARIZONA STATE LANDS

BY JOHN D. GUTHRIE

*Assistant District Forester, Portland, Ore.*

The State of Arizona has a land surface of 72,838,400 acres, or about equal to the combined area of all the New England States (except Rhode Island) and New York. Within the State there is a wide range of elevation, from less than 100 feet above sea level near Yuma to 12,611 feet on the San Francisco peaks. More than half the area of the State has an elevation of over 5,000 feet. All the life zones are represented, except the humid tropical, from the Boreal-Canadian, through the Transition, Upper Sonoran, Lower Sonoran to the Arid-Tropical, all of which are reflected even more distinctly in the flora. Three characteristic physiographic regions are to be noted, the Colorado Plateau, Mountain, and Plains or Desert region. The Colorado Plateau (over 5,000 feet in elevation) includes some 30 million acres, the Mountain (3,000 to 5,000 feet) some 17 million acres, and the Plains or Desert (below 3,000 feet) some 25 million. Arizona's principal timbered area is found within the Colorado Plateau region, which includes the Coconino Forest<sup>1</sup> of some 3,840,000 acres, a part of the largest unbroken pine forest in America. To one unfamiliar with the State it will probably be a surprise to know that 19% of the area of Arizona is forest land, or 14 million acres, of which approximately 3,500,000 acres are of the saw-timber type within National Forests<sup>2</sup> and approximately 1,200,000 acres of saw-timber in Indian Reservations.<sup>3</sup> Generally speaking, her saw-timber forests are found at elevations from 7,000 to 11,500 feet; below 7,000 and down to approximately 4,000 feet the woodland type (pinion and juniper) occurs.

## HISTORICAL

By the Act of Congress of Feb. 18, 1881, the Territory of Arizona, (along with the existing Territories of Dakota, Montana, Idaho and

<sup>1</sup>Not to be confused with the present administrative unit, the Coconino National Forest. The extensive stand of western yellow pine in northern Arizona was known as the Coconino Forest for many years before there were any National Forests. It included all of the present Coconino and Tusayan National Forests and possibly portions of the Sitgreaves.

<sup>2</sup>The net area of the ten National Forests in Arizona is 11,204,304 acres, with 18,653,014 acres within sixteen Indian Reservations.

<sup>3</sup>Four Indian Reservations alone in Arizona are credited with 4,000,000,000 ft. B. M.

Wyoming) received a grant of 72 sections (46,678.68 acres) of land "for the use and support of a university." Arizona was not, however, to gain title until she became a state, which she did by the Enabling Act of June 20, 1910. Under this latter Act, Arizona was the recipient of 2,300,000 acres additional of public land of which 200,000 acres were granted for the State University. This article deals, however, entirely with the 72 sections granted under the Act of 1881, which area was to be selected from the surveyed, unreserved, non-mineral lands of the state. The selection was made in 1882 by a commission authorized by the Territorial Legislature and under the supervision of Superintendent of Public Instruction M. H. Sherman and W. N. Kelly, Register of the U. S. Land Office at Prescott. And here a tribute might well be paid to the sagacity and vision of this Commission and the men who made the field locations for their care in keeping the best interests of Arizona in mind, for be it said that they selected some of the choicest timber sections of the entire Colorado Plateau, in northern Arizona. Of the 46,678.68 acres to which the Territory was entitled, and which the Commission selected, the Federal Government through its Department of Interior rejected 8,869.86 acres (which the State later lost), leaving 58½ sections or 36,790.14 acres of some of the best western yellow pine timber in Arizona, all within Coconino County. The area chosen was not in a compact body but the sections were intermingled with government and railroad grant sections through eight different townships and were estimated to have contained approximately 350,000,000 feet board measure of yellow pine, accessible to the main line of the Santa Fe Railroad and on the whole fairly easy to log. Having no title to these University sections, the Territory could make little or no use of them from 1881 until August 17, 1898, when President McKinley included much of the timbered portion of the Coconino Forest in the San Francisco Mountains Forest Reserve.

This region being an important livestock raising one, the Territory had been able to derive some small returns from the lease of certain of these sections to stockmen for ranch headquarters and pastures. On the other hand the Territory had during these years spent practically nothing on these lands, the Federal Government through the Forest Service (since 1898) having given these sections protection from fire, involuntarily perhaps, because intermingled with government lands, within what later became to be known as the Coconino and Tusayan National Forests.

## ARIZONA'S LAND CODE

By the Enabling Act of 1910 Arizona, now a State, became the owner in fee simple of 36,790 acres of as good pine timber land as to be found in the Southwest.

Arizona's entry into statehood was followed by the holding of a Constitutional Convention. This was followed in 1912 by the session of its first legislature during which among the various state bodies created was a State Land Commission to be made up of three members.<sup>4</sup> The Commission appointed by the Governor was very fortunate in having as its chairman a man whose firm convictions on forest conservation and wise use of State lands has subsequently meant much to Arizona.<sup>5</sup>

The Commission's first task was to examine the State's new land heritage and on the basis of what they found to submit a report of their findings to the Governor. This report was submitted under date of Dec. 1, 1914. The report<sup>6</sup> covered the results of their labors "with such recommendations relating thereto, having for their purpose the establishment of a permanent policy for handling the public lands of the State."

On the basis of this report, which was exhaustive and statesman-like, a State land policy was passed in 1915 by the second State Legislature and known as the "Public Land Code of the State of Arizona." This code contained among many wise provisions for administering State lands several very progressive provisions relating to forestry and forest management of its timber lands. In the title of the Act or Code the purpose is stated among other things to cover "lease, sale and other disposition of the State lands *and of the timber and other products thereof.*" Examples of forestry provisions in the Code are:

*Sale of State Lands*

"Sec. 48—\*\*\*\*\* provided, said lands are not such as are prohibited by law to be sold; and provided that no lands containing timber of such value that it should in the opinion of the commissioner be sold separately from the said land, shall not be subject to sale until after said timber shall be sold, *and no lands chiefly valuable for the pro-*

<sup>4</sup>Arizona Revised Statutes, 1913, Chap. 1, Title 43.

<sup>5</sup>This first Commission was made up of Mulford Winsor, chairman, Cy Byrne and Wm. A. Moody.

<sup>6</sup>Report—State Land Commission of Arizona, June 6, 1912-Dec. 1, 1914.

*duction of saw-timber shall be subject to any of the provisions of this Act, relating to the sale of State lands.*

### *Products of Land*

"Sec. 76—*Rules and Regulations:* Except as otherwise herein provided said rules and regulations for the care, sale and administration of said timber and timber products, shall conform as nearly as may be, to the rules and regulations of the Forest Service of the United States Department of Agriculture.

"Sec. 77—*Limitation of Timber Contracts:* No contract for the sale of timber shall exceed 5 years in term, nor shall more than 50 million feet of timber be sold to any one individual, association or corporation, at one sale, nor shall any sale be made or contract entered into with any person, association or corporation, while such individual, association or corporation, has under sale or contract more than 5 million feet of timber sold under the provisions of this act.

"Sec. 78—*University Timber Account Fund:* The expenses incurred by the commissioner for the care, sale and other administration of timber or timber products, upon lands granted for university purposes, shall be kept by the commissioner in a separate account and said expenses shall be a charge against the said university funds.

### *Trespass on State Lands*

"Sec. 81—*Definition and Punishment:* Whoever knowingly and wilfully commits a trespass upon state lands, *either by cutting down or destroying any timber or wood standing or growing thereon, or by carrying away any timber or wood therefrom, \*\*\*\*\* or negligently or wilfully exposes growing trees, shrubs or undergrowth standing on the state lands to danger or destruction by fire,* or aids or abets any such trespass or injury shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined *not less than \$50 or more than \$300 or punished by imprisonment in the County jail not more than 6 months or by both such fine and imprisonment.* \*\*\*

### COOPERATIVE AGREEMENT

Prior to the adoption by the Legislature of a State Land Code, the Land Commission largely through Mulford Winsor, its chairman, had taken up with the District Forester's office at Albuquerque, N. M., the question of cutting of timber on these university lands. Located as they are intermingled with government timber and private timber

occupying government land (timber cutting rights having previously been secured by local companies on railroad sections later reconveyed to the United States under special agreements) and lumbering operations being in progress, the State realized the opportunity of putting some of its merchantable timber on the market. There followed a cooperative agreement between the Arizona Land Commission and the Secretary of Agriculture which was approved on January 15, 1914.<sup>7</sup> This agreement is still in effect and has therefore passed through its tenth year, with consequent changes in governors and personnel of State land commissioners. This agreement between a state and the Federal Government covered the practice of forestry on certain state lands and contained features unusual at that time and unusual now.

#### SOME PROVISIONS OF THE AGREEMENT

After the usual legal phraseology at the beginnings of such documents, the agreement starts off with a detailed list of the lands affected and a quotation of the Act under which the State Land Commission is authorized to handle these lands, and then follows with a list of the specific things each party to the contract agrees to do.

The Secretary of Agriculture through the Forest Service and the District Forester agrees to:

1. Furnish to the Land Commission the rules and regulations of the Secretary of Agriculture for the administration and use of the National Forest lands.

2. Furnish the Commission copies of fire plans for adjoining National Forests.

3. Advise the Commission as to proper care of said State lands and Forest Service timber sale contracts.

4. Examine, upon request, these university lands and report on their condition, status, products thereof, desirability of timber sales, logging plans, stumpage values, and other matters aiding in proper administration of the lands; *this service to be free of cost to State.*

5. Designate, upon request, forest officers to work for the State in scaling, supervision of logging and other operations connected with removal of timber from these State lands, *salaries and expenses of such forest officers to be paid by State.*

<sup>7</sup>Credit for the inception and putting through of this agreement is due to Arthur C. Ringland, district forester and T. S. Woolsey, Jr., assistant district forester, of the Southwestern District, neither of whom is now connected with the federal forest service.

The State Land Commission on its part agreed to:

1. *Employ at least one fire guard during the fire season who shall work with local forest officers.*
2. Pay all expenses for suppression of forest fires on or originating on these State lands.
3. *Cut and remove timber from these lands as nearly as may be in accordance with National Forest rules and regulations, and the advice given by the Forest Service and consult with the Forest Service before making any sale, the Land Commission however to conduct all negotiations of sale.*

Both parties agreed that if at any time it became necessary to employ a forest officer for administrative or supervision work (as distinguished from advisory, field or office work) that the Forest Service would furnish such a man, or men, and the State would pay him or them, their usual salary and expenses, that the agreement or contract could be terminated upon 90 days written notice. This agreement has been in effect now for some 11 years and there has never yet arisen any discord in its handling in spite of several changes of administrations both state and federal. One or more forest officers have been assigned to the sale as occasion demanded, on a part time basis, salaries being paid by the State only while handling its sales. This forest officer has also handled sales of timber on adjoining government and timber rights sections to the same purchaser. It has been fortunate that the same lumber companies have been the purchasers of all the university timber so far, with whom both the State and the Forest Service have maintained very amicable relations.

#### SALES OF UNIVERSITY TIMBER

Winsor in his report of Dec. 1, 1914,<sup>8</sup> estimated that there were approximately 300,000,000 feet board measure of mature and over-mature yellow pine on the university lands, and that approximately two-thirds or 200 million feet could be marketed within the next twelve years (by 1926). He placed what he considered a reasonable stumpage price of \$3.50 per M feet on it, which he estimated would bring into the university fund of the State a total of \$700,000 for the sale of timber alone there being nominal receipts from sale of cordwood and leases to stockmen. He also believed that "this amount can

<sup>8</sup>Report of the State Land Commission of Arizona, Period, June 6, 1912, to Dec. 1, 1914, p. 123.

be steadily increased at frequent intervals thereafter by the sale of timber not yet mature but so nearly mature that it will soon be suitable for cutting." Let us examine the accuracy of his prediction of 10 years ago.

#### THE PROFITS OF FORESTRY

The first sale of this university timber was made in 1914,<sup>9</sup> since when 15 sales have been consummated to date (Jan. 1, 1924). A total of 128,395,000 feet, B. M. have been sold for which the State has received \$393,179.31. To make and administer these sales, to provide protection from fire and trespass on its 36,790 acres of university lands in Coconino County has cost Arizona \$15,371.14, leaving a net profit to the State for its University fund of \$377,808.17.

TABLE I.

AMOUNT OF TIMBER SOLD, RECEIPTS, COSTS, ETC.\*

Fiscal Year	Volume M. B. M. Feet	Gross Value	Cost Adminis- tration	Net Receipts	Cost Admrs. Per M. Ft.	Average Stumpage Value
1914.....	9,004	\$ 27,012.75	\$ 800.00	\$ 26,212.75	.....	.....
1915.....	20,391	67,365.67	1,800.00	65,565.67	.....	.....
1916.....	18,398	63,964.41	1,680.00	62,284.41	.....	.....
1917.....	7,490	24,342.89	818.49	23,524.40	.....	.....
1918.....	7,319	23,786.75	992.48	22,794.27	.....	.....
1919.....	19,690	60,201.00	1,148.75	58,052.25	.....	.....
1920.....	15,315	50,057.97	3,073.88	45,984.09	.....	.....
1921.....	2,909	8,018.06	1,794.38	6,223.68	.....	.....
1922.....	4,359	10,853.74	956.93	9,856.81	.....	.....
1923.....	23,520	57,576.07	2,306.23	55,269.84	.....	.....
Total.....	128,395	\$393,179.31	\$15,371.14	\$377,808.17	12c	\$3.06

Total amount of timber cut.....128,395,000 feet, B. M.  
 Total area cut over.....18,420 acres  
 Average cut per acre.....6,912 feet, B. M.  
 Average stand left per acre.....1,730 feet, B. M.  
 Total average original stand.....8,640 feet, B. M.

\*Data supplied by R. F. Rhinehart, lumberman, Coconino National Forest.

The State has in addition approximately 160,000,000 feet, of which 31,867,000 feet are in trees left on cut-over sections (on some 18,420 acres) of merchantable timber as yet uncut. It will probably be 15 years before all of the virgin timber on the University sections will be cut. It has approximately 18,420<sup>10</sup> acres of this University land cut over under as good forestry practice and in as good a condition as far as second growth is concerned as the adjoining National

<sup>9</sup>The first scale report on State Sale No. 1 was dated Dec. 20, 1913.

<sup>10</sup>Exclusive of 2,615 acres of open land bearing no timber.

Forest lands. The mature timber has been removed and seed trees left. On most of the cut-over University sections there is good advance reproduction. Based on actually calipered areas, from 15 to 25% of the original stand has been left; in general, approximately 80% of the stand has been taken. The remaining stand consists of thrifty growing "black jack" with occasional yellow pine where needed for safety restocking. Some of the sections are located close to transportation so that there should not be such a long period before a second cut is practicable. Moreover, the State is realizing not a small sum from the sale of dead material, such as cull logs, dead trees, tops and limbs, as fuel wood in the Flagstaff market. The land is being protected and the State can expect to harvest succeeding crops from these lands as time goes on. So far at least, the practice of forestry has proved to be a profitable undertaking for the State of Arizona and its University.

In fact, so successful has been the administration of the timbered lands of the University of Arizona that after the passage of appropriate legislation<sup>11</sup> and after giving the procedure a thorough tryout, the State of New Mexico, through its Land Commissioner under date of September 10, 1923, entered into a similar agreement with the Secretary of Agriculture for the management of all of its timbered holdings—the only material departure being that since the New Mexico lands do not in general alternate with National Forest lands, though largely within or adjacent to National Forests, the State has agreed to pay all the expenses to the Government involved under said agreement including appraisals, technical advice, etc.

<sup>11</sup>Chapter 101, pp. 162-163, Session Laws of New Mexico, 1923.

# THE PHILOSOPHICAL BASIS OF THE "NORMAL FOREST"

By H. H. CHAPMAN,

*Yale University*

*Normality* is the perfect adjustment to external forces.

These forces do not remain constant, and when they change, normality in that respect is destroyed. All organisms are constantly striving for the attainment of normality. But its attainment would indicate the complete cessation of all changes in the external forces, and would result in fixation or stagnation of the organism.

Stability of adjustment too long continued is, therefore, closely associated with death, leads to death and results in death. Continuing and expanding life, on the other hand, results from the interplay of new forces, to which new adjustments must be made.

The survival and improvement of living forms depend on the ability to change in order to adjust the organism to new forces. Two conditions cause the destruction of a species:

- a. Previous perfection of adjustment too long continued, so that the ability to change is atrophied.
- b. Too sudden changes, which exceed the elasticity or ability of the species for adjustment, hence overwhelm it.

In pursuing the ideal of a normal forest these same principles apply.

The forest will ultimately take the form indicated by the forces at work on it of which man controls the age of cutting, the severity of cutting, its frequency, and the conditions determining reproduction.

If the guiding principles, i. e., the rotation, the cutting cycle, and the principle of sustained yield, are adhered to long enough, the forest will automatically become normal as a result of these forces intelligently applied, i. e., whatever form is constructed in the mind of the forester, (if within possibility of nature) will be the form the forest ultimately assumes.

The economic forces, however, on which these ideals are based are not fixed but dynamic or changing—hence the ideals must change. The forest must change with them by modifying the fixed goals, substituting other fixed goals in accordance with the new objectives—thus never attaining perfection.

*But*, too frequent and violent fluctuations of these goals prevent any progress at all towards the attainment of normality. If the change is sufficiently gradual and not too radical the forest may be maintained during the transition as a prosperous going concern.

The transition from virgin forest to forest exploited for lumber is an example of the effect of too violent a change, resulting in destruction of the organism, a process avoidable by adopting more temperate methods of cutting.

The survival of the forest as a *silviculturally* productive unit depends on man's deliberate intention to so modify his attitude towards it that nature can continue to function properly. Its *perfection* as an *economic* productive unit goes farther and requires sustained yield which depends on the three fixed conditions, rotation age, area of working circle, and length of cutting cycle.

The rotation age is fixed for the purpose of producing the largest quantities per acre of the products most needed by society. The area of the working circle is fixed in order to organize a continuous flow of these products at minimum cost. The length of the cutting cycle is fixed in order to secure the best possible combination of silvicultural practice with least logging costs and least administrative expense.

If these conditions, all three, remain fixed, the forest in the course of several rotations will approach closely to perfect adjustment to each goal, simultaneously.

But the very nature of the forces indicated as the basis of these standards is their inevitable tendency to change. Any change in even one of these three basic factors of the forest would throw its form out of perfect adjustment and require another full rotation or longer to bring it back to normal.

In spite of this fact, rotations can be chosen and closely adhered to for periods long enough to attain a form of forest which is a practical going concern, and if changes are required they can usually be introduced without disrupting the business. Since it is easier to shorten than to lengthen a rotation, and the former process spells larger present income as against a curtailment of the present cut, private forests drift towards too short a rotation for permanent economic good or even permanent profit.

Short cutting cycles can be lengthened or long ones shortened without interfering greatly with the annual cut.

The principal service resulting from regulating the cut in the present cutting cycle and first rotation is that the forest inevitably is moulded by such regulated cutting into a form which greatly facilitates its continuance in exactly the same manner during the next rotation.

The success of the working plan for regulation will be based on the foresight with which the three standards, rotation, area and cutting cycle are chosen, and the degree to which they can be adhered to as the best means of rendering the forest permanently useful to the greatest extent.

False judgment, lack of vision or failure to follow the plans laid down will show in corresponding failure of the forest at some future period to give to the community the desired benefits, when it will either be abandoned or new plans adopted, with great economic loss due to disruption of supply of products, caused by the violence of the transition demanded in the forests.

## THE GRAZING OF CATTLE AND HORSES IN PINE PLANTATIONS

*Reply to Comment by J. A. Cope*

BY PAUL W. STICKEL AND RALPH C. HAWLEY

Discussion is stimulating and in the past has been in too large a degree lacking in American forestry periodicals. In most cases men holding opinions differing from those published have been content to remain silent. A live and sustained interest in technical subjects can best be developed by a free interchange of ideas. For this reason we welcome Mr. Cope's comment and shall attempt a brief reply.

Silviculture is local in application. Failure to recognize the general principle as distinct from its local application is often one of the underlying causes for opposing views. For example, Cope's attempt to overthrow our conclusions in regard to the use of transplant planting stock on heavy grass sod in southern Connecticut, by citing the case of one farmer in another forest region, is an excellent illustration of this point.

Will Mr. Cope deny that as a general principle increasing heaviness of sod and luxuriance in grass growth on planting sites tend to require stronger, taller or more vigorous planting stock? We have no quarrel with him as to whether the application of this principle in the upper Delaware River Valley will permit the field planting of two year old seedlings. The authors of the original article in question state specifically that their paper relates to conditions in southern New England (page 846, line 20 of the text).

The fact that removal of dry grass and weeds from unclosed pine plantations lowers the fire hazard is so self-evident as to need no special proof among technical foresters. The relative extent to which the starting and spreading of fires is reduced by grazing, of course, will vary. Under southern New England conditions the difference in fire hazard between a well grazed plantation and an ungrazed plantation is vital. In the former, fire either will not spread at all or else will find such small quantities of fuel that its progress is slow, patchy and of slight injury to the trees.

Grazing was recommended only until the plantation becomes closed (7 to 12 years after establishment). Cope attempts to show that the

fire hazard continues only slightly decreased after closing of the plantation. Experience in southern New England indicates that fires in ungrazed, unclosed plantations run with greater rapidity and are harder to fight than fires in ungrazed, closed plantations. Fires in the latter usually result in base scarring of the trees while fires in the ungrazed, unclosed plantations normally result in total destruction of the plantation. Hence the incentive to reduce the fire hazard for the 7 to 12 year grazing period.

A fire which illustrates the point occurred near New Haven, Conn., on Oct. 26, 1924. Conditions were exceptionally dry, both in the woods and in the open. A fire started beside a road bordering an ungrazed, closed, white pine plantation planted 11 years, and an ungrazed, open red pine plantation six years old. The inflammable material in the closed plantation consisted of pine needles, in the open plantation of grass and weeds 3 to 4 feet high. The fire entered first the closed plantation and burned slowly in the litter, scarring the bases of the trees. Later it reached the ungrazed, open plantation where it ran rapidly and killed the trees on the area burned over. This fire was stopped easily in the closed plantation, but in the open plantation could not be controlled until a fire company arrived with chemical fire extinguishers.

"Live stock grazing as a factor in fire protection on the National Forests," by John H. Hatton, U. S. D. A., circular 134, will prove interesting reading in connection with the reduction of the fire hazard by grazing.

Cope attempts to cast doubt upon our data by claiming that the stock were not confined to the experimental areas but had other pastures to feed upon. He misinterprets the data. With the exception of Plantation E, the stock were pastured entirely within plantations.

However, the authors are willing to meet him on his own ground and assert that in the amount of damage done, the question of whether the grazed plantation is the sole pasture for the stock, is of less importance than the location in the pasture of the plantation with reference to such features as water holes, salting grounds, and travel between different portions of the pasture. In any specified 30 acre pasture in northeastern United States, a one-acre plantation can, by the use of fences or natural features, be so located that practically complete destruction is caused by 15 grazing animals within a year. This can be

made to happen in spite of the fact that the grazing animals are allowed continuous access to all parts of the pasture.

In other words, Mr. DuMond's experiment, as incompletely described by Cope, may or may not be worth anything, even for the upper Delaware River Valley, in indicating the real injury by grazing animals to pine plantations. The experiment does prove what we know and admit, that severe injury *may* result on small areas even when the plantation is only a small part of the area.

Was it good logic for Cope to use this illustration of DuMond's and in the same article attempt to discredit other data because (as alleged), they were secured in plantations which formed a part only of the available pasture?

# CONDITIONS FOR HEAT CANKER AND SUNSCALD IN PLANTS

BY DR. R. B. HARVEY

*Section of Plant Physiology, University Farm, St. Paul.*

In Minnesota the effects of excessive temperatures in plants produced by the absorption of sunlight are frequently seen in the scalding of various fruits, as gooseberries, plums, tomatoes, and strawberries, and in the heat canker of flax. In this latitude the sunshine period is great in summer, for many days more than 15 hours in length. This is a longer period than is shown in tropical regions. When there are no clouds, plants are exposed for a long period to the sunlight and if there is little breeze to dissipate the heat produced by light absorption, the surfaces exposed to the sun become increasingly hotter. During a normal day the highest temperature in exposed surfaces of fruits is not reached when the sun is at the zenith, but afterwards, usually about 2 p. m. The heating effect of the sun is accumulative.

The author has made a great number of determinations of the temperatures reached in parts of fruits and vegetables exposed to the sun. With the apparatus used the temperature of a very small area could be determined accurately. Thermal junctions made by electro welding copper and constantan wire of No. 40 gauge were inserted into the parts of plants at any desired depth. A controlled temperature junction was kept in a mixture of finely chopped ice and distilled water. By measuring the difference of electrical potential between the two junctions the temperature of the plant part could be easily determined, since the junction in ice remains constantly at the freezing point, and the temperature is proportional to the potential difference.

Figure 1 gives the fluctuations in the temperatures of apples on July 13, 1922.

It is easily seen that the south side of the apple is 22° hotter than the shady side of the same fruit and 32° hotter than the surrounding air. With every cloud there is a drop in temperature. Even a slight breeze is sufficient to cause a decrease in temperature. One would expect to find the greatest injury from subscauld on days when there were few clouds and little breeze. A high temperature of the air also favors sunscald, as this decreases heat radiation. A considerable amount of heat is used up in the evaporation of water by the transpira-

tion of plants. Scalding and the effects of high temperature in general are most prevalent when transpiration is decreased by drouth.

The heat canker of flax is caused by excessively high temperatures of the stems at the ground level. On days with bright sunshine the temperature of the surface of the soil was found to reach 126° F. The temperature of the flax stem at the ground level was 123.8°, sufficient to injure most plant tissues, and sufficient to cause heat canker in flax.

In an experiment in which temperatures of flax grown on a dry plot and on wet soil immediately adjacent were compared, it was found that moist soil is sufficiently cooler than dry soil, owing to evaporation of water, to prevent excessive temperature rise in the stems. Injurious temperatures are seldom reached except when the soil is dry.

The scalding of plums, gooseberries, and strawberries is of considerable commercial importance, not only because the scalded fruits present a poor appearance, but also because the scalded areas are easily broken and fungi entering them cause rots.

The temperature of most fruits is considerably higher on the sunny side than on the shady side. Strawberries showed a temperature of 94°, F. on the south side and 82° on the north side when the air temperature was 73.5°. Red currents showed 81° on the south side and 73.5° on the north side when the temperature of the air was 73.5°.

Table I gives the temperatures of plant parts in sunshine and shade taken at various periods.

TABLE I

	Degrees, F. of air temperature	South side degrees, F.	North side degrees, F.
Barley (grain) .....	73.5	77.5	73.5
Pea pod .....	73.5	77.5	73.5
Green cucumber .....	98.6	108.0	
White cucumber (same exposure) .....	98.6	104.5	
Green petiole of beet.....	86.5	101.0	
Red petiole of beet (same exposure) .....	86.5	99.0	
Apple (light red) .....	70.0	103.0	81.0
Bean pod (green) .....	77.5	92.0	87.0
Apple (green) .....	81.0	97.0	81.0

In general, green parts of fruits are heated to a greater degree than red or white parts. The development of red color on the side of apples exposed to the sun tends to prevent excessive heating of the surface. Light green tomatoes scald less than dark green fruits. Red fruits are injured less than green fruits. The reason for this is that the red light reflected from the red fruit contains the greater part of the energy of sunlight. Green fruits absorb this light so that they are heated more than red fruits.

Fruits lying on or near the ground are injured more than those a few inches above the soil. The surface of the ground becomes excessively hot when dry. Some sunscald may be prevented by keeping fruits off the ground. The evaporation of water by the fruit lowers the temperature somewhat, so that watering decreases the injury. Shading either by the leaves of the same plant or by another crop will help to decrease sunscald. The temperature of leaves is seldom excessive on account of the cooling effect of transpiration from the surface.

In strong sunlight gooseberries may have a temperature 10 degrees or more above the air temperature. Sunscald of gooseberries is much worse on plants that have been defoliated by insects than on those with thick leafy covering. Berries on the outside of the bush are most liable to scald. Frequently after a hot, sunshiny day, brown spots with a cooked appearance can be seen on gooseberries. These are typical indications of too high temperatures. Similar discolorations are caused on apples and plums by sunscald.

Fruits ripen more rapidly on the sunny side than on the shaded side because the sunny side is generally at the higher temperature.

#### SUMMARY

It appears that heat cankers or sunscald injuries are caused by the excessive heat generated in exposed parts of plants by sunlight absorption.

The injury is to be expected on days when there are no clouds or breezes, when the soil is dry, and when the average temperature is high.

The injury may be decreased by shading by leaves of the same plant or by a nurse crop; by increasing the soil moisture; or by keeping fruits as far above the soil as practicable.

## ESTIMATING OF TIMBER RESOURCES

Province of Värmland, Sweden

*Extract from Report "Värmlands Taxering"*

TRANSLATED BY E. J. HANZLIK

In order to obtain results in which the personal factor would be eliminated it was decided to gridiron the province by a system of parallel base lines, in an east and west direction, which would be used as control for obtaining the estimates. These lines were spaced 4 kilometers (2.48 miles) apart in the northern part of the province (about three-fourths of the total area estimated) and 2 kilometers (1.24 miles) apart in the southern part. This difference in intensity of the estimate was deemed desirable because of the irregularities of the land surface in the southern portion due to numerous lakes. All trees were tallied along these base lines on a strip 10 meters (32.8 feet) or approximately one-half chain wide, which gave an estimate of 0.25% for the greater part of the province (in the north) and 0.5% for the southern portion. Base lines were surveyed mostly with the magnetic staff compass, although in regions of magnetic ore the solar compass was used. Horizontal distances were obtained with the 100 meter chain (328 feet). The width of strips for estimating was obtained by using a 5 meter stick (16.4 feet) at right angles to the compass line. No vertical control was obtained.

### TREE CLASSES

Trees were tallied in 5 cm. (1.97") classes as follows:

- 0 class, trees up to 4.9 cm. in diameter.
- 5 cm. class, trees 5 to 9.9 cm.
- 10 cm. class, trees 10 to 14.9 cm.

### TRANSLATOR'S NOTE:

The Government of Sweden realized the need of having sufficiently accurate forest data covering the entire country (some 55 million acres of forest land) in order to formulate plans for management of its timber resources, both public and private, and in 1910 an appropriation was made by the Swedish Parliament to start this work in the Province of Värmland, one of the rich forest provinces in south central Sweden, and to devise methods which might be adaptable, with slight variations possibly, to other forest regions of the country. The actual field work was started in 1911, and work was done on what may be termed an extensive basis of estimating.

15 cm. class, trees 15 to 19.9 cm.  
20 cm. class, trees 20 to 24.9 cm.  
etc.

(1 cm. = .394 inches)

In estimating, the 5 cm. class was tallied on a strip 1 meter (3.28 feet) wide; the 10 and 15 cm. classes on a strip 5 meters (16.4 feet) wide; and the 20 cm. and up on a strip 10 meters (32.8 feet) wide. Trees in the 0 class were tallied only on the last 40 meters on a strip one meter wide in each kilometer. (1 kilometer = 0.621 miles.) This method of tallying was due to the excessive number of small trees in this part of Sweden. (In 1910 trial estimating tallied all trees on a 10 meter strip, but it was not practicable to take all the small trees on such a width.)

#### SAMPLE TREES

Every 10th tree (called "A" sample trees) in each diameter class and species was measured with special accuracy (i. e. to mm. at breast height), carefully described as to character, etc., and whether dead. For every 4th sample tree (or every 40th tree) in each diameter class other measurements were also taken for obtaining the volume and growth. These were called "B" sample trees. If especial accuracy was desired, trees were felled and measurements made, otherwise standing trees were measured. Generally the standing trees were measured as accurately as possible. Obtaining the form factor was most difficult—therefore Jonson's form-point method was utilized. Heights were measured with the Christen hypsometer. Increment borings were taken and the growth for the last 10 years was measured at the DBH. The height growth was obtained by observing the tip of the tree and counting back the last 10 years, using the hypsometer. Field glasses aided materially in determining the height growth. For every 40th "A" sample tree (or every 400th tree in each diameter class) additional observations were made on butt-swell and age. These were called "C" sample trees.

#### PERSONNEL

Each estimating crew was composed of:

1 chief

1 tallyman

2 sample tree takers

- 2 caliper men
- 1 compassman
- 2 chainmen

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9 Total in estimating crew

#### LAND CLASSIFICATION

The land surface was classified as follows:

- A. Bldg. lots, garden, agric., tree-less, natural meadow, etc.
- B. Productive forest land used principally for grazing.
- C. Forest land.
- D. Swamps, bogs, etc.
- E. Non-productive land.
- F. Water.

(Also various forest types of no particular distinctive value for U. S.)

On a sample plot of 4 ar (40m. x 10m.) at the end of each kilometer the ground cover was observed according to particularly named groups of plants common in the region—also according to 5 classes of density of ground cover.

#### TREE MEASUREMENTS AND STAND DESCRIPTION

In each forest stand the following was ocularly estimated:

1. *Cu. Vol.*—For each species given in tenths of total volume of the stand.

2. *Age Classes*—In even-age stands under 120 yrs. by six age classes of 20 years each. Older stands were listed as Class VII. Uneven-aged stands, where at least 1-5th of area is taken up by another age-class with a deviation of at least 20 years from the other part of the stand was marked in the age-column "0."

3. *Height*—In even-aged stands the heights of the dominant trees were used as a basis. Height classes were as follows:

Class 0 includes trees up to 3 meters.

3 includes trees from 3 to 6 meters.

6 includes trees from 6 to 9 meters.

9 includes trees from 9 to 12 meters.

12 includes trees from 12 to 15 meters.

4. *Site*—This was obtained from tables for the different species by the actual or estimated tree heights in stands of normal density at 50 years of age.

5. *Density*—Three classes of density were made for stands over 20 yrs. of age.

Class 1. Stands under  $1/3$  fully stocked.

2. Stands  $1/3$  to  $2/3$  fully stocked.

3. Stands over  $2/3$  stocked.

Class 1 was further subdivided as follows:

1-a When the average distance between trees is less than the average height.

1-b When the average distance between trees is over, but not double the height.

1-c When the average distance between trees is over double the average height.

For stands under 20 years density classes were as follows:

Class 0. Distance between plants is over 6 meters.

1. Distance between plants is over 2 and up to 6 meters.

2. Distance between plants is over 2 and up to 4 meters.

3. Distance between plants is not over 2 meters.

If young trees, less than the 20 year class, are under seed trees notation was made of the character of the stand (i. e., young growth under seed trees) and placed under Class 1-b.

6. *History of Stand*—Notation made as to past or present cutting operations according to the following scheme:

1. Uncut forest.

2. Understory cutting.

3. Upperstory cutting.

4. Medium cutting.

#### MAP

A map showing the following was made:

1. Forest types or tree species.

2. Age classes.

3. Height classes.

4. Site.

5. Density of stand.

6. Location of sample plots.

#### ESTIMATING

Trees were measured with calipers 1.3 m. (4.26 feet) above ground and listed in 5 cm. diameter classes, as follows:

Trees 20 cm. and up tallied on strip 10m. (32.8 feet) wide.

Trees of classes 10 and 15 tallied on a strip 5 meters wide.

Trees of class 5 tallied on strip 1 m. wide.

Trees in class 0 tallied on strip 1 m. wide for last 40 meters of each kilometer.

The diameters of all stumps on the 10 meter strip were measured.

#### SAMPLE TREES

Every 10th tree over 1.3 meters (4.26 feet) tall in each diameter class was listed as a sample tree.

("A" trees)—For each "A" sample tree following measurements were taken: (1) number of stand, (2) species, (3) DBH in mm. If dead it is placed in the damaged column.

("B" trees)—For every 4th sample tree (40th tree tallied) in each diameter class the following was obtained in addition:

1. Height.
2. Last 10 years height growth.
3. Formpoint in % of trees' height from ground.
4. Total number of rings at breast height.
5. Width of last 10 rings at breast height.
6. Bark thickness at DBH. (4.26 feet up).
7. Damage—dead tree, rot, fungus, dead top, animal damage, insect damage, snowbreak, fire.

("C" trees)—For each 40th sample tree (each 400th tree tallied) there were obtained data in addition as follows:

1. Diameter at stump height in mm.
2. Age at the base of tree.
3. Diameter in mm. at 1/10 of total height.
4. Bark thickness at 1/10 of total height.

The core showing the growth at base was preserved with an appropriate mark to designate the proper sample tree.

(a) For every sample tree under 1.3 meters (4.26 feet) in height the following data were taken:

1. Number of stand, (2) species, (3) height.

(b) For every 4th sample tree under 1.3 meters was taken:

1. Age at base, (2) last 10 yrs. total height growth, (3) damage.

Every 10th stump was a sample stump—number of stand noted, species, diameter growth in 50 year periods, and indications of rot.

## ADDITIONAL INSTRUCTIONS

There are many instructions given for the proper conduction of the work, such as regarding the need of great care especially with DBH and other measurements, and of the use of checks whenever possible. (Only the more important and those deemed of special interest to American foresters are given in this extract.)

## SITE DETERMINATION—(TREES UNDER 50 YRS.)

Trees of equal diameter 50 years of age at breast height and 60 years at base are on better sites than those having 65 or 70 rings at base. The ground cover is also an indication of site, especially with young growth, for example:

Herbs and good grass—site value 21 meters at 50 yrs. of age.

Moss, blueberries, herbs 18 meters at 50 yrs. of age.

Heath, moss, huckleberry 15 meters at 50 yrs. of age.

Heath, huckleberry, lava 12 meters at 50 yrs. of age.

Lava, white moss, moss, huckleberry 9 meters at 50 yrs. of age.

For trees over 50 years of age site tables are based according to the height at 50 years.

## DENSITY

1. Uncut forest—not over 10% of volume cut.
2. Understory cutting—at least 10% cut. Stumps left have an average diameter less than the diameter of the remaining trees at stump height.
3. Upperstory cutting—at least 10% cut; average diameter of stumps greater than that of the remaining trees.
4. Medium cutting—at least 10% cut from both upper and understory.

## LABOR AND WAGES—(SUMMER 1911)

Left camp 7 a.m. 1 hr. at noon—worked on 60 hr. week basis.

Wages—Chief 10 kr. per day (week days only).

Others 2 kr. per day (week days only).

Others 1 kr. per day (including Sundays and Holidays).

(1 krona, Swedish=26.8 cents par value.)

Crew averaged trifle over 5 km. of line per day (3.1 English miles per day). Very few rainy days and the weather therefore was very

favorable for field work. In May there were 7 days of rain, June—9 days, July—7 days, Aug.—8 days, Sept.—17 days = total 48 days out of 153 days, of which only 12 had more than 5mm. (0.197 inches) precipitation.

## RESUME

Strip lines 10 meters wide, situated 4 km. apart (northern portion) gives 0.25% estimate, 2 km. apart 0.5% estimate. Strip lines were run in east and west direction across the entire province. Strip surveys gave a total area of 1,931,282 hectares (4,770,000 acres, approx). Govt. surveys showed 1,932,352.5 hectares or a difference of 1,070.5 hectares, or 0.0554%. Official figures (latest) give the area 1,932,408 hectares (4,773,068 acres).

## LAND CLASSIFICATION

(1 hectare = 2.47 acres)

Forest area	1,194,806 hectares = 61.8%
Grazing & Pasture	73,052 hectares = 3.8%
Swamps, etc.	191,646 hectares = 9.9%
Agric. & Homes	249,520 hectares = 12.9%
Mountains, Roads and	
Water	223,384 hectares = 11.6%
Total	1,932,408 hectares = 100.0%

## TIMBER STAND

The number of trees tallied on the strip line was 1,309,863 trees of all sizes and species. The total number of trees on the full width strips (10 meters wide) was estimated to be 11,509,133 trees.

By diameter classes the distribution is as follows for the province:

0 cm. class ( 0 to 4.9 cm.)	65.43%
5 cm. class ( 5 to 9.9 cm.)	18.31%
10 cm. class (10 to 14.9 cm.)	9.56%
15 cm. class (15 to 19.9 cm.)	4.32%
20 cm. class (20 to 24.9 cm.)	1.61%
25 cm. class (25 to 29.9 cm.)	0.56%
30 cm. class (30 cm. & up )	0.21%
	100.00%

In the English system of measurements 83.74% of the trees were under 4 inches DBH, 13.88% from 4 inches to 8 inches DBH and only 2.38% over 8 inches in diameter.

Of the tree classes from 10 cm. (3.94 inches) and up in diameter spruce (*Picea excelsa*) comprised 51.63%, pine (*Pinus sylvestris*) 35.59%, other species (birch principally) 12.78%.

AVERAGE VOLUME PER TREE BY DIAMETER CLASSES  
(EXCLUDING BARK)

Tree Class	Volume in Cubic Decimeters (All Species)	Volume in (x) Cubic Feet (All Species)
0 (0"-2")	1.313	0.046
5 (2"-4")	14.282	0.5
10 (4"-5.9")	52.667	1.9
15 (5.9"-7.9")	125.73	4.4
20 (7.9"-9.9")	239.96	8.5
25 (9.9"-11.8")	385.24	13.6
30 (11.8"-13.8")	567.27	20.2
35-50 (over 13.8")	940.61	33.2

(x) Volume in cubic feet computed by translator from metric system of measurements. 1 cubic decimeter = 1/1000 cubic meters = 0.03531 cubic feet.

CUBIC VOLUME PER TREE OF PINE AND SPRUCE IN CUBIC DECIMETERS  
(EXCLUDING BARK)

Diameter Class	Pine	Spruce
0	1.439	1.482
5	13.455	14.117
10	48.233	53.537
15	116.44	130.46
20	226.58	253.07
25	363.63	417.28
30	548.63	605.99
35	809.20	894.28
40	1053.3	1202.1
45	1190.0	1687.0
50	1427.0	.....

NOTE: To reduce above to cubic feet multiply by 0.03531.

TOTAL ESTIMATED CUBIC VOLUME FOR PROVIDENCE OF VARMLAND IN  
CUBIC FEET

Diameter Class	Pine	Based on "A" Sample Trees			Total	Dead in % of Total Volume
		Spruce	Birch	Others		
0	668,288	1,310,958	815,341	445,185	3,239,772	0.25
5	2,422,318	4,797,494	2,002,110	724,372	9,946,294	1.44
10	5,302,180	10,401,801	2,664,863	790,863	19,159,707	0.92
15	7,217,209	10,742,344	2,056,086	663,071	20,678,710	0.85
20	6,594,189	6,703,535	1,054,615	347,837	14,700,176	0.63
25	4,408,522	3,079,263	503,982	180,239	8,172,006	0.59
30	2,070,210	1,110,647	251,770	135,837	3,568,464	0.65
35	912,368	426,812	110,065	52,431	1,501,676	1.49
40	336,538	140,576	86,600	43,102	606,816	1.20
45	94,835	54,772	18,287	28,572	196,466	3.58
50	64,118	11,657	46,884	.....	122,659	9.50
Total . . . . .	30,090,775 36.7%	38,779,859 47.4%	9,610,603 11.7%	3,411,509 4.2%	81,892,746 100.0%	

## TOTAL VOLUME OF DOWN TIMBER

Diameter Class	Number of Trees	Volume in Cubic Meters	Volume Per Cent
0-10	1,694,000	85,832	19.9
15	892,400	113,024	25.14
20	440,800	104,480	23.24
25	170,000	64,144	14.27
30	51,200	27,028	6.01
35	22,400	18,589	4.14
40	11,600	13,324	2.97
45	6,000	7,682	1.71
50	10,800	15,412	3.43
Total . . . . .	3,299,200	449,515	100.00%

NOTE: To obtain volume in cubic feet multiply by 35.31.

## VOLUME ACCORDING TO AGE CLASSES AT DBH

(a) Cubic Volume in % of age-class for different diameter classes  
(Add 10 yrs. to get actual age)

Age Class	Diameter Classes				Totals 0 to 50
	0	5	10 & 15	20 & 25	
	Percent	Percent	Percent	Percent	Percent
I	52.88	12.78	1.89	.....	4.56
II	35.13	45.45	27.62	9.88	23.83
III	10.07	28.53	33.80	25.17	29.18
IV	1.56	9.85	19.19	23.56	18.90
V	0.12	2.44	9.64	15.92	10.60
VI	0.24	0.54	4.29	10.54	5.88
VII	.....	0.41	3.57	14.93	7.05
Total	100.00%	100.00%	100.00%	100.00%	100.00%

(b) Cubic Volume in % of diameter classes for different age classes

Age Class	Diameter Classes				Totals 0 to 50
	0	5	10 & 15	20 & 25	
	Percent	Percent	Percent	Percent	Percent
I	45.85	34.02	20.13	.....	100.00
II	5.83	23.17	56.38	14.62	100.00
III	1.37	11.87	56.35	30.41	100.00
IV	0.33	6.33	49.39	43.95	100.00
V	0.04	2.79	44.24	52.93	100.00
VI	0.16	1.11	35.51	63.22	100.00
VII	.....	0.70	24.66	74.64	100.00
Total	3.95%	12.15%	48.65%	35.25%	100.00%

The average cubic volume for the entire Province is 42.34 cubic meters per hectare (605 cubic feet per acre).

## ANNUAL INCREMENT

The observed annual increment for the Province of Värmland amounts to 2,744,541 cubic meters (excluding bark), or approximately 97 million cubic feet.

By species the annual increment is as follows :

Spruce.....	1,320,080 cubic meters	47.79%
Pine.....	924,107 cubic meters	34.01%
Birch.....	370,433 cubic meters	18.20%
Other Species.....	129,921 cubic meters	
Total.....	2,744,541 cubic meters	100.00%

The average annual increment for the productive forest area is 2.23 cubic meters per hectare (31.9 cubic feet per acre).

## AVERAGE INCREMENT (PER TREE) BY DIAMETER CLASSES

Diameter Class	Pine		Spruce		Birch		All Species	
	Average Increment Per Tree in Cubic Decimeters	%	Average Increment Per Tree in Cubic Decimeters	%	Average Increment Per Tree in Cubic Decimeters	%	Average Increment Per Tree in Cubic Decimeters	%
0	0.0319	2.27	0.0109	0.74	0.0224	2.12	0.0188	1.47
5	0.7621	6.00	0.6269	4.65	1.0331	6.90	0.7693	5.68
10	2.0740	4.49	2.0895	4.06	2.8878	5.04	2.2148	4.38
15	3.8998	3.47	4.4043	3.49	5.0461	3.80	4.2926	3.52
20	5.8317	2.64	7.4723	3.04	9.0766	3.65	6.8085	2.92
25	7.9625	2.24	10.561	2.60	11.224	2.80	9.0905	2.41
30	9.5422	1.77	13.391	2.26	14.829	2.92	11.359	2.04
35	10.288	1.29	20.607	2.36	8.0000	1.06	.....	.....
40	14.333	1.40	26.571	2.23	.....	.....	.....	.....
45	11.000	0.93	.....	.....	.....	.....	.....	.....

NOTE: To obtain increment in cubic feet multiply by 0.03531.

For the entire growing stock the average growth percent is 3.54%.

## FOREST TYPES

The typing of the productive forest area shows the following principal forest types and their percentages:

Mixed conifer (excluding hardwoods).....	31.2%
Pine .....	21.3%
Spruce .....	17.7%
Hardwood .....	5.8%
Hardwood Spruce .....	9.0%
Hardwood Pine .....	3.2%
Hardwood Pine Spruce .....	11.8%
	100.0%

## SITES

Site Class		Height		% of Product Forest Area	
		Meters	Feet		
Poor Sites	0	0-2.9	0-9.5	0.5	11.4%
	3	3-5.9	9.8-19.35	2.3	
	6	6-8.9	19.7-29.2	8.6	
Medium Sites	9	9-11.9	29.5-39.0	21.0	82.6%
	12	12-14.9	39.4-48.9	34.6	
	15	15-17.9	49.2-58.8	27.0	
Good Sites	18	18-20.9	59.1-68.6	5.4	6.0%
	21	21-23.9	68.9-78.4	0.6	
	24	24-26.9	78.8-88.3	0.028	
	27	27-	88.6-	0.003	

DIFFERENCES IN AGES BETWEEN BASE OF TREE AND DIAMETER AT BREAST  
HEIGHT BY SITE CLASSES

Species	Sites															
	Poor						Medium						Good			
	0		3		6		9		12		15		18		21	
	No. Trs.	Yrs.	No. Trs.	Yrs.	No. Trs.	Yrs.	No. Trs.	Yrs.	No. Trs.	Yrs.	No. Trs.	Yrs.	No. Trs.	Yrs.	No. Trs.	Yrs.
Pine.....			12	14.6	89	12.5	151	10.3	298	8.0	238	7.1	47	6.6	4	6.6
Spruce.....	1	13.0	6	25.2	50	15.1	179	14.5	472	10.2	461	8.6	91	7.3	21	8.4
Hardwoods...					10	9.4	15	9.9	67	7.9	60	8.5	18	7.9	3	4.3
			Average						Average						Average	
Pine.....			101	12.8					687	8.2					51	7.7
Spruce.....			57	16.1					1112	10.2					111	7.5
Hardwoods.....			10	9.4					142	8.4					21	7.4

## PRODUCTIVE FOREST AREA BY AGE CLASSES

Age	Class	Percent of Total Forest Area	Percent Excluding Cut-Over Area
1- 20	I	12.7	13.8
20- 40	II	20.6	22.3
40- 60	III	18.7	20.3
60- 80	IV	11.8	12.8
80-100	V	5.5	6.0
120-140	VI	3.4	3.7
140-	VII	2.3	2.5
Uneven aged.....		17.2	18.6
Cut-Over.....		7.8	....
Total Productive Forest Area..		100.0%	100.0%

## FOREST AREA AND DENSITY

Density	% of Prod. Forest Area	% by Age Classes							
		Uneven Aged	I	II	III	IV	V	VI	VII
Grade 3: Over $\frac{2}{3}$ stocked.....	60.9	62.0	59.9	76.3	74.0	65.8	51.9	41.0	45.2
Grade 2: $\frac{1}{3}$ to $\frac{2}{3}$ stocked.....	21.2	27.4	25.2	16.9	18.6	23.6	29.5	32.8	35.6
Grade 1: Under $\frac{1}{3}$ stocked.....	9.7	10.6	12.0	6.7	7.4	10.6	18.6	26.2	19.2
Grade 0: Young growth spaced over 6 meters.....	0.4	.....	2.9	0.1	.....	.....	.....	.....	.....
Cut-Over Area.....	7.8	.....	.....	.....	.....	.....	.....	.....	.....
Totals, Forest Area..	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

## NOTES ON THE PROVINCE OF VARMLAND AND ITS FORESTS

The Province of Värmland is in the south-central part of Sweden, an inland province with rolling topography, situated north of Lake Venner, the largest lake in Sweden. The soil is morain, consisting of rock, stones, gravel, and finer material. The subsoil is granite and gneiss. Generally, the soil is lacking lime.

The climate is favorable to tree growth, the growing season being from the latter part of May to the end of September. There is more rain here than in other parts of Sweden. (The amount is not stated.)

#### FOREST HISTORY

The cutting of Värmland's forests dates back a long time, as timber cutting for the iron industry was practiced there in the early days of the country. The iron industry requires a great amount of charcoal, and even in the past this industry was very important. The Uddeholms iron works have been in operation since the sixteenth century; the present company, Uddeholms Bolag, dates from the seventeenth century. This company purchased much timberland in the early days, and at the end of the first hundred years had 75,000 hectare (185,000 acres).

Formerly, in order to protect the charcoal industry, lumber and timber were forbidden to be exported. However, the policy changed in the early years of the nineteenth century, and about 1825-30 a start was made in the lumber and timber export business from Värmland via the Port of Gothenberg. About the same period also the company officials began to think about rational forestry practice, and steps were soon taken to put the lands under management. Forest management can be considered to have attained a very high development in Värmland, it being one of the first regions in Sweden to undertake to place its forest lands under forestry practice.

Värmland is considered one of the richest provinces from a forest standpoint and forest culture has reached a wide development.

#### POSSIBLE FOREST PRODUCTION

The future estimated production can be increased over the present as cutting advances into the still undeveloped forest areas. With an estimated productive forest area of 1,194,806 hectares (2,950,000 acres), 180,500 acres cut-over, with an 80-year rotation and 5-year regeneration period (based on Pressler's formula), the growth is estimated as follows:

Present working capital = 915 cubic feet per acre (exclusive of bark).

Under normal stocking it is estimated there can be obtained:

80 year rotation 1,137 cubic feet per acre

100 year rotation 1,458 cubic feet per acre

120 year rotation 1,715 cubic feet per acre

The growth increment in 1910 was calculated at 97 million cubic feet, not counting the amount cut during the winter of 1910-11, having

an increment during 1910 which should be added to the calculated increment. With an estimated cut of 109 million cubic feet in the winter of 1910-11, and allowing a growth of 2.5% on it, there should be added a growth of 2,750,000 cubic feet additional. There is, also, some increment in the young growth (O-class) which would add about 1,900,000 cubic feet more. Another source of increment is that of planted forests, amounting to some 1,550,000 cubic feet. This makes a grand total of 103,200,000 cubic feet as the annual increment in 1910. The above figures indicate that the cut in 1910 slightly exceeded the present annual growth.

#### FUTURE PLANS

The general plan of the Swedish Government is to complete the estimating of the forest areas within the five-year period, starting with the field season of 1923. Two provinces were covered therefore during the past year (1923). The general scheme used for obtaining the estimates in Värmland will be followed; however, the distance between the base lines used for estimating purposes will be varied to a far greater degree. Thus, in the more densely populated and smaller provinces the strips will be two kilometers apart (1.24 miles); namely the Island of Gottland; those south of the Provinces of Kopparberg and Gävleborg will be four kilometers (2.48 miles) distant; in Jämtland, Kopparberg, Gävleborg and Västernorrland 10 kilometers (6.21 miles) distant; while in the extreme northern Provinces of Norrbotten and Västerbotten the base lines will be spaced 20 kilometers (12.42 miles) apart. The intensity of the estimate is determined on the need for obtaining more or less accurate data.

The labor and other costs in 1923 amounted to considerably more than in 1911, as the average wage in Sweden is now about 50% higher than it was before the war. Subsistence and other costs have also risen in the same proportion, and in some instances even doubled.

Most of the work to be done in the future will be somewhat more difficult than in Värmland, as the less accessible regions comprise the greater portion of the area, thus necessitating moves of greater distances, camps distant from supply bases, many tent camps, etc. It is expected, however, that an average of five kilometers (3.1 miles) of line per day will be estimated by each crew. The party organization as used in the Värmland estimate is deemed suitable for this estimating work, the great variety of data obtained and the large number of stems necessitating a strip crew such as enumerated in the foregoing.

## THE SPRUCE BUDWORM IN NEW MEXICO

By W. J. PERRY,  
U. S. Forest Service

Call him *Harmologa*—, *Tortrix*—, or *Cacoccia fumiferana*. Take your choice. He is the same moth or caterpillar and eats just the same amount of buds under either name. Also he has been here before and we still have some forests, and, under conditions in the Southwest the writer considers him not at all an unmixed evil. In fact were it not that he inevitably sets an awful fire trap every time he visits us, the writer believes his activities result in more good than harm in our mixed Douglas fir—white fir stands of timber. I am not sure but that we should assume the extra risk and thank him for coming, at least so long as we handle our forests on a sawlog and not a pulpwood basis.

Without *Harmologa* our Douglas fir type of country grows up to a perfect jungle usually with the white fir predominating. It is frequently so thick that it becomes stagnant and only after a great many years do some dominant trees get above the multitude and really start to grow. Even then many of these are the comparatively worthless white firs which in turn promptly seed up every foot of chance openings in the forest as they may occur. Then, in 30 or 50 years, *Harmologa* swoops down in her millions and each female deposits some 200 eggs at strategic points, placing them 12 to 15 in a cluster on the lower side of the needles. After a few days an extremely small but extremely lively and able-to-take-care-of-himself yellowish green worm emerges from each egg and secretes himself about the tree. Early the next spring the worm bores into an unopened bud and as growth starts consumes the young leaves. The attack is on!

All the short-needed trees, firs, spruces and Douglas fir, are attacked with the white fir or "balsam" as first choice. Next year the same thing occurs—only multiplied by thousands—and the next and the next! We do not know yet what brings these attacks to a close. Probably the shortage of food supply has most to do with it. There is some evidence that the present attack is being somewhat weakened after four years by some disease of the caterpillars.

What happens to the white fir is that growth is immediately checked and very light annual rings are laid on, except that the first year the growth is particularly heavy near the *base* of the tree only. As the attack continues and no new leaves are allowed to develop and the old ones cease to function as elaborators of the tree's food, the growth becomes less and less and the tree dies from the top downward in about

10 to 12 years and sometimes considerably less. When the attack is not complicated by the girdling beetle very thrifty specimens may survive the attack. Large trees have many of their main branches killed and frequently a large "spike top" results. While not yet present in the attack now in progress, there is abundant evidence on the ground that in past time a girdling beetle (*Scolytus* or *Eccoptogaster*) has helped to put many of the weakened white firs out of their lingering misery.

What happens to the Douglas fir is that the less thrifty small trees and others weakened from mistletoe, etc., are killed just as the white fir except for the beetle. The larger trees are checked in growth and have the tips of their branches and probably their leaders killed. Hence we often see much dead wood in an old crown and a new leader, slender, white-barked and shining, and looking like a young tree set on top of an old one. Occasionally the very old trees are so badly killed back as to be spike topped for a third or more of their height. The thrifty young trees of pole size and up are seldom or never killed. They suffer the usual retardation of growth for a dozen years and then, being freed from competition for light and moisture through the death of the white fir and their weaker companions, and the worm attack being now over, they reproduce their crowns and make a much more rapid growth than they were making previous to the attack. The old trees do not possess this degree of recuperative power and may never resume normal growth.

To the writer's mind, more and better timber is actually produced on a typical Douglas fir—white fir site over a period of say 50 years which includes an attack somewhere near the beginning than on one which does not.

What happens to the forest is, that while the type and quality of timber is without doubt improved, the dead trees standing, and for some years after they are down, constitute a tremendous fire hazard. It seems quite clear that many of our old clean burns in the Douglas fir and Alpine types cannot easily be accounted for in any other way than that they followed attacks of the budworm, when there was enough dead material standing and down to create an intensely hot fire and kill all and even the largest remaining timber. The ordinary litter in the virgin forest would not and does not accomplish it.

It is necessary and of everyday practical value in forest management that we be able to look forward and visualize conditions as they will probably be half a hundred years or more from now. What has happened in the past half-hundred years under various conditions, if

intelligently interpreted, may throw a flood of light into the future. It is said that "history repeats itself." Certainly forest history does. For ages man has tried to pry into and read the future. The best he has ever accomplished, however, was to read the *past* more or less correctly and predict the future in some measure from that.

Much of the "ancient history" of the forest may be come at by close observation of such things as the type, density, scars, thrift, forest litter, etc. Many additional facts may be gained by aid of an increment borer. It is good to know as much as possible of the ancient history of the forest in order to be able to predict with some degree of certainty what may be expected from the future. While looking forward let us occasionally take a peep through the "hind sights." It helps a lot!

In the course of a progressive study of the present attack a typical site was selected and in addition to a study of the dead and down timber, etc., many increment borings were taken. The present stand is pure Douglas fir from 12 inches to 24 inches d.b.h., is as thick as desirable and growing thriftily. There is abundant evidence on the ground that up to 1884, forty years ago, the stand contained at least 50% white fir and that it was much too crowded. Borings show that growth was very slow at that time in all trees. In 1872 there was an attack by the budworm and for the 12 years following growth was exceedingly slow, being only about 40% of the previous slow growth under the crowded conditions. Then, in 1884, the attack having probably passed entirely, and the white fir having mostly died, the Douglas fir began slowly to resume growth. But with the tips of their branches and often their leaders dead the trees had to produce practically a new crown before any great amount of wood could be laid on. Accordingly for the following 22 years the increase in growth was quite gradual, but by 1906 all the white fir being dead and down they had full possession of the ground, full light, and their new crowns were now complete and functioning to the fullest. The response was immediate and rapid. In the last 18 years—1906 to 1924—the growth was equal to that of the previous 34 years! The trees are starting to slow up their growth as a result of the present attack but they are young and thrifty and they *will not die*.

This area was not burned over after the attack of 1872. Adjoining it, on the same slope and under identical conditions, there is an area that was burned over, however, and not a merchantable sized tree remains. This latter area is now a veritable jungle of stunted, stagnant and slow growing young timber, mostly white fir with an occasional Douglas fir reaching up. The writer does not hesitate to predict that

as a result of this attack practically all the white fir and much of the Douglas fir will die, and that as a result the area will be for several years in a condition to burn like a stubble field. Also, that if it does not burn, there will be enough Douglas fir left to make a complete stand, and that the remaining white fir will probably be eliminated by another attack in 30 to 50 years leaving a practically pure stand of Douglas fir. All right then, set up a promise card to re-examine this area in 1974! I will not be here, but am willing to leave a bet to be redeemed, or collected, by my great grandson!

The above statements and conclusions apply to mixed stands of Douglas fir and white fir in the Southwest where the latter species is notoriously defective and, as we are aiming to produce lumber, is little more than a weed taking up much valuable space capable of producing the more valuable species. It is not intended to, and probably does not, apply to other localities such as the North and East where great damage is actually being done in stands composed largely of species susceptible to killing by the worm.

On the whole the writer does not consider the situation one over which we need lose much sleep, though admittedly it looks pretty scary at first glance to see all the timber turning brown. Anyway, there seems not much we can do about it except of course to harvest where we can those species subject to killing by the insect before they reach the age where the tree's declining vitality cannot successfully resist the attack. Also, we must not forget the added fire danger due to the dead timber.

## REVIEWS

"*The Normal Sal Selection Forest.*" Indian Forester, December, 1924, pp. 638-644.

Every forester engaged in teaching forest management should read Trevor's letter on the normal Sal selection forest. The letter is a reply to Howard who had denied "that the diameter class distribution in a selection forest is the same as that for a uniform forest." Trevor's letter is really an article replete with diagrams and curves. He not only gives theoretical figures, but compares them with actual data from various compartments. Trevor's arguments in favor of the practical value of comparing the normal with the actual stand in selection forest marking is not original. The idea was originated by A. Schaeffer (of the French Forest Service) and the idea was explained in "Studies in French Forestry" pages 216, 217, 257, 258 and text.

T. S. W., Jr.

"*Hemlock: Its Place in the Silviculture of the Southern New England Forest.*" By Perry H. Merrill, Research Fellow, Yale University, and Ralph C. Hawley, Professor of Forestry, Yale University. Yale University: School of Forestry Bulletin No. 12.

This bulletin on New England hemlock stands (or should I say "clumps"?) by Merrill and Hawley shows that the species will produce more lumber per acre than the oaks and less than red or white pine. It has the advantage of great tolerance and longevity, but is extremely susceptible to fire and also to ring shake when more than 100 years of age.

The bulletin contains volume tables, evidently prepared with great care—and with great difficulties. The authors state: "The results obtained for logs up to 20 inches in diameter were checked by a mill tally taken on 193 logs. As the figures secured by the two methods fell close together it is fair to assume that the values secured by diagram for logs over 20 inches in diameter are correct." The reviewer would draw different conclusions. If the results of the mill tally agreed with the results of the diagrams, it would appear that the mill tally was too high. The two sets of figures *ought not to agree* for the diagram, while allowing for some kerf, cannot allow for the practical loss in sawing at local mills, nor for loss because hemlock logs are not as cylindrical as logs drawn by diagram. Moreover, it is understood the diagrams for ties were based on the small end of the log d. i. b. In actual practice the

railroad measurement is taken about where the rail rests on the tie. The yield tables for pure stands, although evidently prepared with equal care, may prove of doubtful value because of the impossibility of securing uniform sample plots for considerable areas. Out of the entire 62 plots upon which the yield study was based only one plot covered more than one-half an acre and *no less than 33 plots are less than one-fifth of an acre in area!* Judging from my own experience with yield plots of very small area, I doubt whether accurate yield data have been obtained. Undoubtedly, the authors collected the best possible material under existing conditions. Judging from what Behre says on page 66—"it resulted in inharmonious values"—there was considerable difficulty in concocting the yield figures. Perhaps this was in part due to these small-sized plots. The authors state on page 34: "Instead the method proposed by William N. Sparhawk was adopted," while Behre states on page 66: "The method finally employed. . . . was to draw a maximum and minimum curve along the top and bottom, etc." Is this the Sparhawk method? If it is, it's at least a century old.

Exception might be taken to the arguments in favor of a method of silviculture that will produce pure stands of hemlock. The authors advise the removal of the hardwood over-story where there is an under-story of hemlock. Then they advocate assisting the young hemlock in its competition with the hardwood reproduction by "cutting back" operations in order to secure a pure stand. There is some doubt in my mind whether this pure hemlock stand is desirable in the majority of cases. Would it be better to allow selected hardwoods and white pine to grow up in mixture with the hemlock—gradually thinning the stand during the period it grows from 20 to 60 years of age? Why strive for pure hemlock stands? Taken all in all, have not the authors overestimated the value of pure hemlock?

The authors do not speak of price increment—obviously of great interest in forest management, and it would have been interesting if they had discussed the subject of rotations somewhat more at length. Nor are their few words on rotation fully convincing.

A problem and a very important one (which bulletins of this class cannot hope to answer) is: "What will be the yield in hemlock stands after thinnings?" As a matter of fact during the next one-half century, all hemlock stands under forest management will be thinned. Obviously, the figures published in this bulletin could hardly indicate the yield from thinned stands since the plots measured were largely in wild,

unthinned groups and stands of trees. Bulletins of this sort, even if *very preliminary* in character, are a step in advance, but it is hoped that Forest Schools with liberal endowments for research will at once establish permanent sample plots which can be thinned and re-measured at regular intervals. What a pity more money was not spent on permanent and properly thinned sample plots between 1905 to 1910. Wasted opportunities can never come back. Moreover, it's a pity that schools publish such statements as (p. 65) "Bruce has demonstrated the fact that height growth on fully stocked plots is greater than on those understocked." Is this a discovery? Foresters were aware of this truism in the Middle Ages and certainly it is not necessary for the Yale School of Forestry to republish such elementary laws generally accepted by the profession.

T. S. W., Jr.

*"The Distribution of the White Oak in Minnesota."* By Frederick K. Butters and C. Otto Rosendahl. Minnesota Studies in Plant Science. Studies in the Biological Sciences Number 5, November, 1924.

The distribution of the white oak in Minnesota is discussed in detail by Butters and Rosendahl in this paper with particular attention to the soil factors as limiting its distribution. A map shows the locations of stations where white oak is known to occur and also the general relations between the distribution of the white oak and the major forest types of the state.

It shows that the occurrence of the white oak is distinctly related to the distribution of the red non-calcareous clays of the Early Wisconsin glaciation which support this species and the gray calcareous clays of the Late Wisconsin drift upon which it does not occur. An analysis of the soils supporting white oak and soils where white oak is absent shows that more than 0.5 per cent calcium carbonate in the soil limits the establishment and growth of the white oak. These observations were substantiated by greenhouse experiments with white and burr oak seedlings grown in soils containing chalk and kaolin. The white oak seedlings grown in the calcareous soils were not only stunted but had strongly chlorotic leaves.

In southeastern Minnesota where the white oak occurs it is shown to be dominant on the non-calcareous soils only and is supplanted by the burr oak on the calcareous soils.

A. E. W.

*"Timbers of Tropical America."* By Samuel J. Record, Professor of Forest Products, Yale University, and Clayton D. Mell, Tropical Forester. Pp. xviii + 610, plates 51, 6½x10. Published by Yale University Press, New Haven, Conn., 1924.

This book very obviously represents a vast amount of painstaking study and labor. It appears to be as complete as the present status of our knowledge of tropical American forests permits. Even then it is only a pioneer in the literature relating to the tropical forests of America. Years of work remain to be done in the way of exploration of the forests, naming or identifying the trees and determining the properties and uses of their woods before a complete book can be written. Heretofore the literature on tropical American woods was available principally in pamphlet form, much of it of little value and reliability. For the first time we have in one book a comprehensive mass of information culled from the best of that previously available and with an additional and possibly a greater mass that is entirely new. The subject matter gives evidence of caution and conservatism in its presentation and an absence of an attempt at meaningless space-filling to bridge gaps in the author's knowledge. The book is to be highly commended on its freedom from superficiality. It impresses the reviewer as an exceptionally thorough piece of work on the part of the authors, from the excellent preface to the very complete index, and a beautiful piece of typography on the part of the publishers.

"Timbers of Tropical America" is a particularly timely book. Interest in the forests of other countries, stimulated by the knowledge that our own forests are nearing exhaustion, is growing rapidly. American wood users have looked especially toward the American tropics as a possible source of timber when that of the United States is gone. This book will help them overcome the handicap in obtaining authentic information relating to this region. Many wild statements have been made and many erroneous beliefs have obtained currency concerning the character of the tropical forests. Some have minimized the seriousness of our domestic timber situation in the belief that we can go to the tropics and obtain timbers of any species in any quantity. Some few have believed that conifers predominate in the Amazon basin. A large number believe the tropical forests consist of only very hard and heavy or very beautiful cabinet woods. There is some excuse for this belief, because for generations the tropics of North and South America have furnished the world with the justly famous mahogany, Spanish cedar, rosewood, cocobolo, lignum vitae, greenheart and others, difficult

to surpass either for beauty or for hardness. In the preface is the interesting and encouraging news that, of the great number of species growing in the tropics, those that are soft and easy to work and are plain in appearance outnumber the hard and heavy or beautiful woods, despite the fact that with almost negligible exception the tropical forests are made up of broad-leaved trees rather than of conifers. There is a "noticeably large proportion of general utility woods which have escaped attention, but which have great potential value for all sorts of industrial purposes." The single conifer occurring in commercial quantities—the Parana pine of southern Brazil—will probably never be of importance in commerce outside of South America. Offsetting the fortunate presence of many soft and plain timbers is their occurrence in, for the most part, rather light and much mixed stands; furthermore, access to many sections appears to be very difficult. "The forests which offer the best opportunities, from the standpoint of supplying the United States in the early future, are located in Mexico, Central America, northern South America, and the lower Amazon."

The book is in two parts. Part I is devoted exclusively to the countries of the tropics, from Mexico and the Islands southward. Each country is considered under separate titles and information is given on physical features, important rivers, population, and the vegetation. This part is rather brief and one might have expected a great deal more descriptive matter on the forests themselves, their accessibility, the woods labor difficulties, etc., in view of the wide experience of the author of this part in the tropics. However, the book is bulky enough and for our present needs the information included is probably ample.

Part II makes up the bulk of the book and is the best and most immediately useful of the two. In this part are described the individual woods, a large number of them, representing 75 families and 180 species or classes of woods, are described in detail. There are several thousands of species in the tropics, making the number described in detail appear small; however these are the most important ones or those to which the attention of the trade has already been directed. Many more species are mentioned, probably just as far as information was available or their importance justified. The descriptions are presented as follows: First, under a heading indicating the family, e. g., *Moraceae*, are given some general family characteristics, relationships, and other general data. Following this, come descriptions of each genera of the family, e. g., *Chlorophora*, *Bagassa*, *Clarisia*, *Brosimopsis*, and others. Descriptions of genera are in greater detail, and call attention to the number of spe-

cies in the genus, their distribution and perhaps some historical reference is made. The important tree species are enlarged upon and described; the importance of their products in the dye industry, as in the case of *Chlorophora*, is touched upon, as is their exploitation. Before another genus is described, the wood of the genus as a whole or its principal species is considered in great detail according to a definite schedule, e. g., to use *Chlorophora* again, there are given the common native and trade names, in this case over 80 of them. Then follow the following paragraph side headings: general properties, growth rings, wood parenchyma, pores, vessel lines, vessel contents, rays, ripple marks, gum ducts, minute anatomy, remarks, and source of material studied. Each species that is taken up in detail is covered somewhat in this manner. Part II is therefore necessarily and properly repetitional as to form. Very little work having ever been done in the way of making strength tests on tropical woods, there will be found very little data on mechanical properties.

One of the most harassing details to the student of or dealer in tropical woods is the utter and discouraging confusion in the nomenclature. This may be surmised from the example of *Chlorophora* given above. Professor Record has done an excellent work, a great service to future students and to the anticipated traffic in tropical American woods by diligently tracing out and correlating the many synonymous terms and names. This part of the work alone will make the book invaluable to dealers in these woods.

The reviewer hesitates to enter some criticisms of such an excellent work. First, there should have been included a map of the regions covered. This might have saved some space in Part I. Second, the book will be difficult to use by those not accustomed to any but very popular works. The treatment is decidedly academic. Third, the styles of type setting off the family, genus, and wood descriptions are too similar. There should have been more decisive styles used or different spacing when a new family was taken up. These shortcomings are, however, not serious.

The index adds great value to the book. It covers 50 pages, three columns to a page, is very complete and simple to use. With such a multitude of names—7,500 are given—a carefully prepared and complete index was absolutely necessary.

E. F.

"*The Watermark Disease of the Cricketbat Willow (Salix caerulea)*." By W. R. Day, Mycologist, Imperial Forestry Institute, Oxford. Oxford Forestry Memoirs, No. 3. 30 pages, 17 figures. Oxford University Press, American Branch, New York. 1924.

A disease of *Salix caerulea* caused by *Bacterium salicis* n. sp., is reported from England. The symptoms are a general progressive wilting of leaves and dying of branches, frequent production of adventitious shoots, and a bacterial exudation chiefly through insect wounds. Characteristic darkly stained areas, known as watermarks, occur in the affected parts, being first found in the one year old annual ring, and later spreading to the central tissues and the current year's growth. Infection always takes place in the crown, through wounds. The inoculum is disseminated by wind, rain, and perhaps to a large extent by insects. The organism is a strictly vascular parasite but causes occlusion of only a limited number of vessels. Secondary causes of wilting is the production of by-products from the bacteria and the dead parenchymatous cells. It is recommended that trees should be planted at least 20 feet apart, avoiding marshy soils or those having wet subsoils, and that general hygienic measures be observed.

*Cytospora chrysosperma* was found to attack branches affected with the watermark disease. It was shown to be a weak parasite, incapable of attacking healthy vigorous plants.

R. M. N.

"*Skogalmanak (Forest Almanac)*." By Julius Nygaard, Grondahl & Son, Oslo, 1925, 320 pages, kr. 7.50.

Nearly every European country has its forestry almanac. This little book, published for several years in Norway, is richer in contents than ever for 1925. While of interest primarily to Norwegian foresters, many of the tables, such as those for determining site qualities, and for the conversion of metric to English units, will be of value to the profession elsewhere. Lists of wood-using industries, communal forests, foresters, forestry and driving associations; current log and stumpage prices for each forest region, log rules, volume tables, laws, methods for growth study, estimating, planting—these are some of the multitude of subjects treated—and, best of all, the printer has contrived to keep it all in such small compass that it fits easily in an ordinary pocket. In size and arrangement of contents, it may well be a model to American forestry almanac publishers.

H. I. B.

"*Factors Controlling Forest Successions at Lake Itasca, Minnesota.*" By Shun Ching Lee. The Botanical Gazette, Vol. LXXVIII, No. 2. October 1924.

Lee presents in this paper a detailed discussion of all the climatic, edaphic, and biotic factors which control forest successions, especially for northeastern Minnesota, and he has compiled and assembled for convenient use statistics of climatic factors for the region discussed. In addition he conducted experiments in evaporation, light intensity, soil moisture, temperatures, and precipitation which confirmed generally accepted premises but which are valuable in that they give a quantitative index for this particular locality.

In treating the successions and climax associations he recognizes the usual forest types and places them in successional order with edaphic climax types of jack pine, Norway pine, and hardwood-white pine; together with their intermediate transformational stages. The regional climax which Lee predicts will ultimately occupy all sites differs from that proposed by Bergman and Stollard in 1916 for the same general locality. They decided that the white and Norway pine type was the climax while Lee decided that the *Abies-Picea canadensis* type is the climax form. In this connection Lee states, "A true climax forest is not determined by present quantitative predominance of certain species, but by the continuity of their reproduction in the habitat which they are occupying." It occurs to the reviewer that "present quantitative predominance" might not determine the climax but would strongly indicate it. Lee observes that the pine forests are being invaded by the fir-spruce type and that it will supersede the pine types. To the reviewer, it seems improbable that ecologists should seem to make their determinations of climax types just when the change is occurring. Though this region is not old geologically yet there must have been many consecutive generations of pine stands, which have a life cycle of not over 300 years. But it is just this present existing generation of pines which is being superseded. Perhaps many of these previous pine stands were also on the verge of being superseded but managed, somehow, to reproduce themselves.

Lee qualifies his predictions by saying "Should there be no external disturbance." But can one justly so qualify a discussion of natural types? Biologists recognize the Balance of Nature law where forms of animal life are constantly held in check by other forms and by food supply. Should not plant ecologists recognize some such principle also

and consider it as a factor in the life histories of the forms of life with which they especially deal? When the fir-spruce type should become extensive enough a Forest Entomologist would predict a spruce budworm epidemic which would effectively hold at least the balsam in check. Lee considers this as a factor which would influence succession but the reviewer would consider it an integral part of succession.

Perhaps if the natural life-histories of our forest types were first adequately determined we could more reasonably predict successions and climax types. At present, however, but little is known of the true life-histories of the forest types of this region.

Lee's contribution is comprehensive and complete and is well illustrated. It indicates painstaking work and is strictly after the school of the ultimate in succession. He disagrees, however, with the two other studies dealing with successions and climax types in northern Minnesota, which, in turn, disagree with each other. Cooper found a climax of spruce, fir, and birch on Isle Royal; Bergman and Stollard determined the white pine-Norway pine type to be climax for northern Minnesota; and Lee proposes a fir-spruce climax; lacking the birch of Cooper's climax type.

A. E. W.

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Compiled by Helen E. Stockbridge, Librarian, U. S. Forest Service.

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## NOTES

### NOT FOG BUT FIRE FIGHTING

Editor:

Your attention is called to a gross misstatement of facts in a note that appeared on page 94 of the January issue of the Journal. The note in question is a Jules Verne version of the fire quenching abilities of a Pacific fog.

While it is true that fog partly checked the spread of this fire during parts of several days by raising the relative humidity the fire was by no means quenched. Fire lines had been previously constructed entirely around the burning area, but were being patrolled awaiting the arrival of rain, which came September 22. It rained heavily for 36 hours, but within a few hours after the weather cleared it was again necessary to put men back on the fire until more rain fell.

The Journal wishes to publish facts only, and being on this particular fire myself during the fog period and thereafter, I know whereof I speak, which is further attested by the signature of the Supervisor, who visited the fire.

*Olympia, Washington, Feb. 2, 1925*

J. H. BILLINGSLEA

R. L. FROMME

### EUROPEAN TOUR

Dr. C. A. Schenck, former director of the Biltmore Forest School, will guide the party of students from the Pennsylvania State Forest School at Mont Alto, on their annual tour of the forests of Germany and Switzerland.

Dr. J. V. Hofmann, former director of the U. S. Wind River Forest Experiment Station, will have charge of the party, which will consist of not more than 20 men, and will include as many members of other forest schools as can be accommodated.

The party will sail from New York on March 28 and Dr. C. A. Schenck will conduct lectures in Silviculture and Management on the outward voyage, continuing the series of lectures given at Mont Alto early in January.

During the tour through the German and Swiss forests with the Mont Alto Forest School students last year, Dr. Schenck was able to secure the services of the forester in charge, with the history and working plans, and often invaluable historical maps. His knowledge of the American and European forest conditions leaves him without a peer as a guide and lecturer in this field.

The tour will also include some of the French forests.

THINNING EXPERIMENTS IN SCOTCH PINE (*PINUS SYLVESTRIS*)  
IN SWEDEN\*

The data presented here are for thinning experiments in pine forests near Bispgården in Jämtland, Sweden. Experiment No. 40, Plot I, was established in 1905 in a then 60-year old, very densely stocked natural stand. A heavy low thinning was made at that time, followed by a similar one five years later when the stand was 65 years old. At 70 and 75 years of age, extra heavy low thinnings were made, the last in 1920. In connection with this last thinning an unthinned area in the same stand situated similarly to the thinned plot was measured for comparative purposes.

The total number of trees was reduced from 4,550 per acre at 60 years of age to 405 per acre at 75 years. In the unthinned stand there remained at 75 years a total of 2,812 trees per acre. The total volume production (up to 75 years) was greatest in the thinned stand with 5,090 cubic feet per acre, of which 3,310 cubic feet, or 65 per cent, was taken out in the form of thinnings in the course of the four thinning operations. The volume of the unthinned stands was 4,080 cubic feet per acre at the same age.

The radial growth at breast height was obtained for the last 20 years with the increment borer. It was found that the growth before the thinnings, at 60 years of age, was the same on both plots, but that the radial growth gradually increased in the thinned stands. This increased growth was found to be in keeping with the increase in volume production. Furthermore, it indicated the radial growth in the different years, and in particular emphasized the general variations in climatic conditions for the period.

Of special interest is the current growth. For the past three 5-year periods, this has been respectively 46, 100.6, and 108.5 cubic feet per acre per year. A summary of the data in 1920 for the thinned and unthinned plots at 75 years of age is as follows, all figures being on a per acre basis:

Condition of Plot	After Thinning					Thinnings	Total Production
	Total Trees	Basal Area	Average Height	Volume Av. Diam. Breast High			
Thinned.....	405	Sq. Ft. 73.40	Feet 48.6	Inches 5.75	Cu. Ft. 1,780	Cu. Ft. 3,310	Cu. Ft. 5,090
Unthinned...	2,812	184.40	42.0	3.46	4,080	.....	4,080

\*Skogsbruk, Trävaru-och-Pappersindustrie, Specialkatalog, Jubileumsutställningen i Göteborg 1923, pp. 102-103. Translated by E. J. Hanzlik.

The four thinnings have taken out a total volume of 3,310 cubic feet per acre in the 15-year period (1905 to 1920). The thinning percentages amounted to 34.5 in 1905, 26.2 in 1910, 21.6 in 1915, and 29.1 in 1920.

E. J. HANZLICK.

#### A FORMULA FOR THE SCRIBNER RULE

At least two attempts have been made in the past to express the values of the Scribner Rule in algebraic form. The first was by Daniels, who used the equation of the parabola  $V=a D^2+B D+C$ , which is consistent with Clark's work in deriving the International Rule. His method of determining the constants by means of only three values is, however, crude and inaccurate, for different triads of values will yield radically different constants. His result (modified to apply to 16-foot logs), is  $V=.74 D^2-.73 D-31$ . It seems probable that there was some mistake in his computations, for the resulting equation does not agree with a single value from the rule.

The second attempt was by McKenzie, who by a rather involved and unsatisfactory process of reasoning produced:

$$V=\left[(1-.266) \frac{11 D^2}{4 \times 12}-3\right] L.$$

For 16-foot logs this reduces to  $V=.77 D^2-48$ .

A preferable method appears to be to accept the formula suggested by Daniels, but to determine the constants therein by the method of least squares. If this be done, using values from 6 to 40 inches, but to shorten the computation using the values for even inches only, the following equation results:  $V=.79 D^2-2D-4$ . This agrees very closely with that for the  $\frac{1}{4}$  inch International Rule, which, when modified to apply to 16-foot logs becomes:  $V=.80 D^2-1.4 D-4$ .

The extension of the Scribner values to large diameters by the U. S. Forest Service was by an entirely different method. It is therefore of interest to compare the three formulæ with the Forest Service standard table. For  $D=100$  inches we have:

Daniels' formula .....	7296
McKenzie's formula .....	7652
Least square formula.....	7696
Forest Service standard value.....	7720

The complete set of values for even inches from 6 to 40 follows:

DBH	Actual Value	Formula Value		
		Daniels	McKenzie	Least Square
6	18	—8	—20	12
8	32	10	1	31
10	54	36	29	55
12	79	67	63	86
14	114	104	103	123
16	159	146	149	166
18	213	196	201	216
20	280	250	260	272
22	334	311	325	334
24	404	377	396	403
26	500	450	473	478
28	582	529	556	559
30	657	613	645	647
32	736	704	740	741
34	800	799	842	841
36	923	902	950	948
38	1068	1010	1064	1061
40	1204	1124	1186	1180

The superiority of the new formula, particularly for the smaller diameters, is apparent.

With this formula it is possible to obtain an algebraic expression for overrun, if we accept the essential accuracy of the International Rule. The difference between the International and Scribner values is:  $(.88D^2 - 1.52D - 4) - (.79D^2 - 2D^2 - 4) = .09D^2 = .48D$ .

Expressed in per cent of the Scribner values this is:

$$\frac{.09D^2 + .48D}{.79D^2 - 2D^2 - 4} \times 100 = 11.4 + \frac{90}{D} + \frac{285}{D^2} + \dots$$

all terms of this series after the first three being negligible. In a similar way, for the International  $\frac{1}{4}$  inch kerf rule the overrun per cent is:

$$1 + \frac{80}{D} + \frac{200}{D^2} + \dots$$

In both cases the importance of the terms containing D indicates the high influence of log diameter on overrun.

—DONALD BRUCE.

## SOCIETY AFFAIRS

### NEW ENGLAND SECTION

The New England Section held its annual meeting in Boston on February 13. The general subject of discussion was present policies and future plans in forestry departments of the New England States presented by representatives of each of the New England state forest departments except Rhode Island. About 50 members and 8 guests were present. Prof. R. C. Hawley, Yale School of Forestry, was elected chairman and H. O. Cook of the Massachusetts Department of Conservation was made secretary.

The business session aroused considerable discussion and at its close two resolutions were passed, the first condemned the "Outlook" for the Gregg article criticising the Forest Service and the second, which concerns the members of the Society follows.

"We hold that the profession of forestry is not confined in its scope to technical facts, but includes also the economic field embracing forest policy and legislation, be it resolved that we protest against the action of the Executive Council seeking to prevent the participation of the Society in questions of policy and legislation and declare that in our belief the scope of the Society should be as broad as the profession of forestry itself."

### CENTRAL ROCKY MOUNTAIN ELECTION

At the recent election of the Central Rocky Mountain Section, Prof. Gordon Parker of Colorado Springs, Colorado, was elected chairman; Mr. Ress Phillips of Colorado Springs, vice chairman; Mr. E. S. Keithley, also of Colorado Springs, was elected secretary-treasurer. Mr. Parker may be addressed in care of Colorado College, and all the other gentlemen, in care of the Forest Service.

E. W. TINKER.

### NORTHERN OHIO VALLEY SECTION OF THE SOCIETY OF AMERICAN FORESTERS

#### *Minutes of the Second Annual Meeting*

Clifty Falls Park, Ind., Oct. 16, 17 and 18, 1924.

The Second Annual Meeting of the Ohio Valley Section of the Society of American Foresters was held at Madison, Indiana, October 16, 17 and 18, 1924, at the Clifty Falls Park, and at the Clark County State Forest at Henryville, Indiana.

*Business Meeting at Clifty Hotel, October 16*

The meeting was called to order at 8:10 P. M. by Chairman Burr N. Prentice of Purdue University.

The following members and visiting foresters were present:

Burr N. Prentice, Purdue.

L. J. Young, Ann Arbor.

P. A. Herbert, East Lansing.

C. C. Deam, Indianapolis.

G. R. Phillips, Indianapolis.

Edmund Secrest, Wooster.

F. W. Dean, Wooster.

O. A. Alderman, Wooster.

Brewster, Cincinnati.

B. E. Leete, Portsmouth.

Visitors:

Sen. Guthrie of Indiana Conservation Commission.

J. A. Mitchell of Lake States Section.

J. J. Crumley, Athens, Ohio.

G. C. Martin, Chillicothe, Ohio.

John Withers, New Marshfield, Ohio.

Clyde Withers, New Marshfield, Ohio.

S. G. Harry, Wooster.

The minutes of the first annual meeting at Wooster, Ohio, Nov. 2 and 3, 1923, were read and approved.

State Forester Secrest gave a report with reference to the prospects of securing an Ohio Valley Forest Experiment Station. He said that the U. S. Forest Service is trying to get two more stations. While there had been no chance of the Forest Service securing these stations the past year there were hopes that it might be able to do so in the coming year.

Secretary Russell Watson was expected to be present at this meeting, but was unable to do so. On account of his removal to Wisconsin, he has now become affiliated with the Lake States Section. In his absence, Bernard E. Leete of Portsmouth, Ohio, was appointed Secretary *pro tem*.

Professor L. J. Young, Chairman of the Membership Committee, reported that the names of all prospective members had been acted upon by the committee which had forwarded its recommendations to Prof. Bryant, of New Haven.

State Forester Secrest urged that we should try to increase the membership of our section pointing out that there were still a considerable number of foresters within our territory who were not members of the Society. The constitutional provisions regarding membership were discussed by various members present.

Prof. Prentice called attention to the great need of securing appropriations to make the Clarke-McNary Act operative, and that appropriations were just as essential under this act as under the Weeks Law.

Mr. Brewster of Cincinnati suggested that the Chairman appoint a committee that should write every senator and congressman urging them to support acts of appropriation to make the Clarke-McNary Act effective, and that this committee report at the next meeting and give their replies. This motion was seconded and passed.

Chairman Prentice called the attention of the meeting to the proposal for the employment of a paid secretary for the National Society who should also participate in the sectional meetings. Reference was made to the Journal and to the reports from the other sections, especially to the New England section where a majority is reported as favoring this proposal. There was no definite expression of opinion as to this matter by the meeting.

It was voted that the Chair appoint a nominating committee which should report on Saturday its nominations of officers for the section for the ensuing year. Young, Brewster and Leete were named by Prof. Prentice.

An address of welcome was made by Senator W. A. Guthrie, Chairman of the Conservation Commission of Indiana. Senator Guthrie first outlined the plans for Friday, especially the proposed excursion to the State Forest at Henryville. He then told in outline of the development of conservation and forestry in Indiana. In 1904 a law and appropriation had been adopted for the acquisition of 2,000 acres in Clark county, land which comprised 17 run-down farms, the very poorest in the state and from which even the timber had been all stripped off. This was bought as an experimental area, and the speaker commented upon the regrowth that had been secured on this state forest both through planting and by natural regeneration. He said that U. S. Forester Greeley and Mr. Tillotson of the Forest Service had estimated that the State should acquire two and one-half million acres of land for state forests. The sites of early settlement in Indiana had been on the

southern hills, where 85,000 acres of woodland per year had been denuded. The high flats had been in years past covered with magnificent stands of white oak timber. Some of the areas that had been acquired as game refuges and state parks were described. Senator Guthrie expressed the opinion that the private operator was not likely to practice forestry. Public ownership only will work, he said. Mention was made of the Indiana Forest Tax Law, and in closing of the public attitude toward forestry—the cropping of timber in Indiana. The meeting adjourned at 9:50 p. m.

*Friday, October 17th, 1924—Excursion to Henryville*

The section started out by automobile for the State Forest at Henryville at a seasonable hour, and for about two hours previous to the noonday repast explored the State Forest and inspected the greatly diversified experiments in forest planting that have been undertaken under the direction of State Forester Deam. Each visiting member was provided with a copy of Bulletin No. 6 of the Division of Forestry entitled "Guide to the Clark County State Forest." This bulletin gives a detailed record of each plot and plantation. The highest point of the Forest was visited before the return to the Administration Building, where all partook of an excellent chicken dinner served outdoors by the Ladies' Aid Society of Henryville. After dinner still other sections of the forest were visited, particular attention being given the plantation work, not to mention the individual studies made en route in the palatability of the indigenous hickory nuts and persimmons. Completing the tour of the Forest, a group photograph of the party was taken in front of the Administration Building and the automobiles were again brought into service and headed at least some of the time toward the Clifty Hotel which was reached by somewhat devious routes shortly after nightfall.

Arriving at the hotel, the Section enjoyed a banquet arranged there by the Indiana Conservation Commission. Postprandially, the principal feature of the occasion was an address by Colonel Richard Lieber, Director of the Indiana Conservation Commission, on "Forestry in Relation to the Public Welfare," which was very much enjoyed by all present.

*Saturday, October 18, 1924*

The Section and others interested in the proceedings met in the Assembly Room of Clifty Hotel for the open meeting whose time of

beginning was advanced about an hour in order to facilitate an early closing. The meeting was called to order at 8:10 A. M. by Chairman Burr N. Prentice of Purdue.

Prof. L. J. Young, of Ann Arbor, extended to the Section an invitation to meet in Michigan for its next annual meeting, the details and arrangements to be worked out in cooperation with Prof. A. K. Chittenden of East Lansing. The Section voted its acceptance.

The nominating committee made its report and proposed the following names as officers for the coming year:

Chairman, L. J. Young.

Secretary, A. K. Chittenden.

Member of Executive Committee, Edmund Secrest.

The Section approved the report and these members were elected as nominated.

George R. Phillips, Assistant State Forester of Indiana, was the first on the speaking program, and addressed the meeting on "*Woodland Inspection Under the Indiana Forest Land Tax Reduction Act.*" An abstract of his paper will be found in the appendix to these minutes, and a copy of the entire paper is in the secretarial files of the Section.

The next paper on the program was "*Forest Fire Protection in Ohio,*" by Bernard E. Leete, in charge of forest protection in that State. An abstract of this paper is in the appendix.

Third on the program, State Forester Deam of Indiana addressed the meeting on "*Some New Aspects of Forest Taxation.*" The program secretary was unable to properly record the inimitable wit which pervaded Mr. Deam's remarks, and which delighted the assembly in spite of the rather somber color of his topic.

Prof. L. J. Young of Michigan next held the floor and ably discussed the intricacies of a proposed *forest type classification for the Lake States*. An attempt has been made to indicate the trend of his remarks in the appendix hereto attached.

At the close of Prof. Young's paper, Brewster of Cincinnati proposed that the Chair appoint a committee and present at the next meeting a tentative outline for a forest type classification for the Ohio Valley, the same to be presented at our next meeting. The motion was seconded and passed.

Dr. Elliott of Purdue University sent his regrets at being unable to attend the meeting of the Section.

Dr. J. Stanley Coulter, dean of the School of Science at Purdue

and a member of the Conservation Commission, was also scheduled to speak at this time, his topic being "*The Immediate Problem.*" All present regretted that it was not possible to hear Dr. Elliott and Dr. Coulter.

Mr. Raphael Zon, director of the Lake States Forest Experiment Station, was also unable to attend the meeting, but J. A. Mitchell was able to represent the Station and gave a brief outline of some features of its program.

The order of the meeting next called for the reports of the State Foresters. State Forester Deam also made some remarks as to progress in forestry in Indiana.

The meeting voted to send abstracts of the various talks to the Journal of Forestry, that the secretary write a letter of thanks to the Conservation Commission of Indiana, and also to the Ladies of Henryville for their respective kindnesses in providing for the entertainment of the Section.

The meeting adjourned for an early dinner at the Clifty Hotel. After dinner Senator Guthrie urged that the members in returning should take the time, if possible, to see some of the scenic features of the Clifty Falls State Park and also some other points of interest that could well be taken in by those returning home over a northerly route. This kind invitation was accepted in whole or in part by those whose itinerary permitted, but several had to leave immediately for distant destinations and the number was limited to those who were able to indulge in further sightseeing. All left with a feeling that the meeting had been a marked success in every way.

BERNARD E. LEETE, *Secretary pro tem.*

#### NORTH PACIFIC SECTION

The officers of the North Pacific Section for 1925 are as follows:  
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